



# THE INDIAN JOURNAL OF SURGERY

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Index for 1947

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# THE INDIAN JOURNAL OF SURGERY

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No. 2

## URINARY CALCULI

by L. B. JOSHI, M.B.B.S. (Bom.), F.R.C.S. (Eng.).

The history of urinary stones is as old as that of human beings. The chemical compositions of stones of antiquity and of those of to-day are unchanged. Knowledge about the aetiology of urinary stones is, however, still incomplete, leaving a great deal of scope for research. If the problem of urinary stones is solved it would go a long way towards solving the problem of other stones in the body.

A brief account of the applied Anatomy and Physiology of the problem may not be out of place. The nephron or uriniferous tubule is 20 to 40 u in length. Each kidney contains one million of these units. The total filter area of the two million glomeruli comes to well over one square foot. Normally the output of urine for 24 hrs. is given as 1500 C.C. i.e. 62.5 C.C. per hour. However, about 1200 C.C. per hour is the maximum excretion possible. Thus ordinarily only 5% of the kidney tissue is working at any moment. In animals three-fourths of the kidney tissue has to be removed before the blood urea rises, showing inadequate kidney function.

Certain teleostean fish have kidneys which are aglomerular i.e., without the presence of glomeruli and all the urine is secreted by the tubules. It is probable that the first convoluted tubules in human beings also perform a similar function. Specialization of certain cells or tissues make their functions more specific and limited. In the first convoluted tubules there is only one type of cell, cuboidal, with abundant mitochondria tending to get arranged in longitudinal rows. The cells have a non-vibratile brush border edge. This structure is suggestive of secretory activity. How can one accept without reserve statements made that these cells

perform many functions such as re-absorption, secretion, formation of hippuric acid, ammonia and phosphates? Blood returning from the glomerulus and the urine from Bowman's capsule are physically balanced and any further exchange between these fluids without definite cell activity is impossible. Most probably the 1st convoluted tubules actively secrete the colloids, acids and certain organic matters which cannot be filtered by the glomerular filter. The whole structure of the nephron is suggestive of a flush system. The ample fluid from the Bowman's capsule washes down the solids secreted in the first convoluted tubule.

The loop of Henle gets fresh supply of blood and again physical exchange between the urine in this part of the tubule and the fresh blood is possible. The flat cells of the descending loop of Henle are similar to those of the capsule and permit physical exchange. Re-absorption takes place in the descending loop of Henle. The structure of the mucosa of the 2nd convoluted tubule is very similar to that of the 1st convoluted tubule, but the brush border edge is not seen and the mitochondria are more definitely arranged in lines more perpendicular to the basement membrane. It is stated that the loop of Henle and 2nd convoluted tubule have similar functions. The structure of the descending loop of Henle is very different from that of the ascending part of the loop of Henle and both are different from the structure of the 2nd convoluted tubule. It appears to be obvious that each of them must be performing different functions.

In corrosive sublimate poisoning, it is the ascending loop of Henle and the convoluted tubule (probably second) that show necrosis.



The uriniferous tubule is the basic unit of the urinary system. Not enough is known about its physiology. The formation of urinary calculi must be due to some fault in the working of this unit.

A number of pigments and solids get deposited in the kidney under various circumstances, as shown in the following table.

Pigment or deposit.	Site where lodged.	Disease in which these are seen.
Blood.	Convolutud tubule.	Destruction of Haemoglobin e.g. pernicious anaemia.
Bile.	Convolutud tubule.	Jaundice.
Bilirubin infarct.	Apices of Pyramids.	Jaundice.
Melanin deposit.	Loop of Henle.	Melaninuria.
Glycogen deposit.	Loop of Henle.	Van Gierk's disease. Severe diabetes.
Uric acid infarct.	Yellow streaks at apices of Pyramids & deposits in collecting tubules.	In new born babies.
Calcified necrotic submucous patches.	Loop of Henle and convolutud tubule.	Corrosive sublimate poisoning.
Casts.		Nephritis.

The insoluble deposits and casts in this list are the seeds of the stones that form later.

Though the problem of the aetiology of urinary stones is complex, there are certain general observations which help a great deal in the investigations.

### THE STONE WORLD

Urinary stones occur in human beings all over the world but in certain regions they are extremely common, in others not so frequent and in still other parts they

are very rare. Urinary stones are common in China, Northern India, Persia, Arabia, Mesopotamia, Palestine, Dalmatia, the Volga Valley, the Balkans, Parts of France, Egypt and parts of England, especially Norfolk. In North America Urinary stones are uncommon; cases are seen in certain regions of South California and South Florida.

In Germany, Austria, Czechoslovakia and Hungary the incidence of Urinary stones has of recent increased remarkably due to economic distress.

Full-blooded Eskimos are almost immune from Urinary calculi; yet, in Iceland, the condition is prevalent among the Scandinavian population. In South Africa the native population of Johannesburg does not suffer from Urinary stones whereas the condition is tolerably frequent among the white people of the region (Johannesburg Med. Annual 1937).

To understand the cause of the above distribution further study of each region is essential.

### DISTRIBUTION OF STONE IN CHINA\*

There are two outstanding centres.

(1) In the South, around the Canton area extending South-West to the City of Fatshan and to the South-East to the city of Tung-kun. It is confined to the delta of West River (SIKIANG RIVER).

(2) HWAIYAN in ANHWEI province. There are two other centres of importance.

(1) In the Southern parts of Central Hunan with Shaoyang as an important centre but extending South to Lingling.

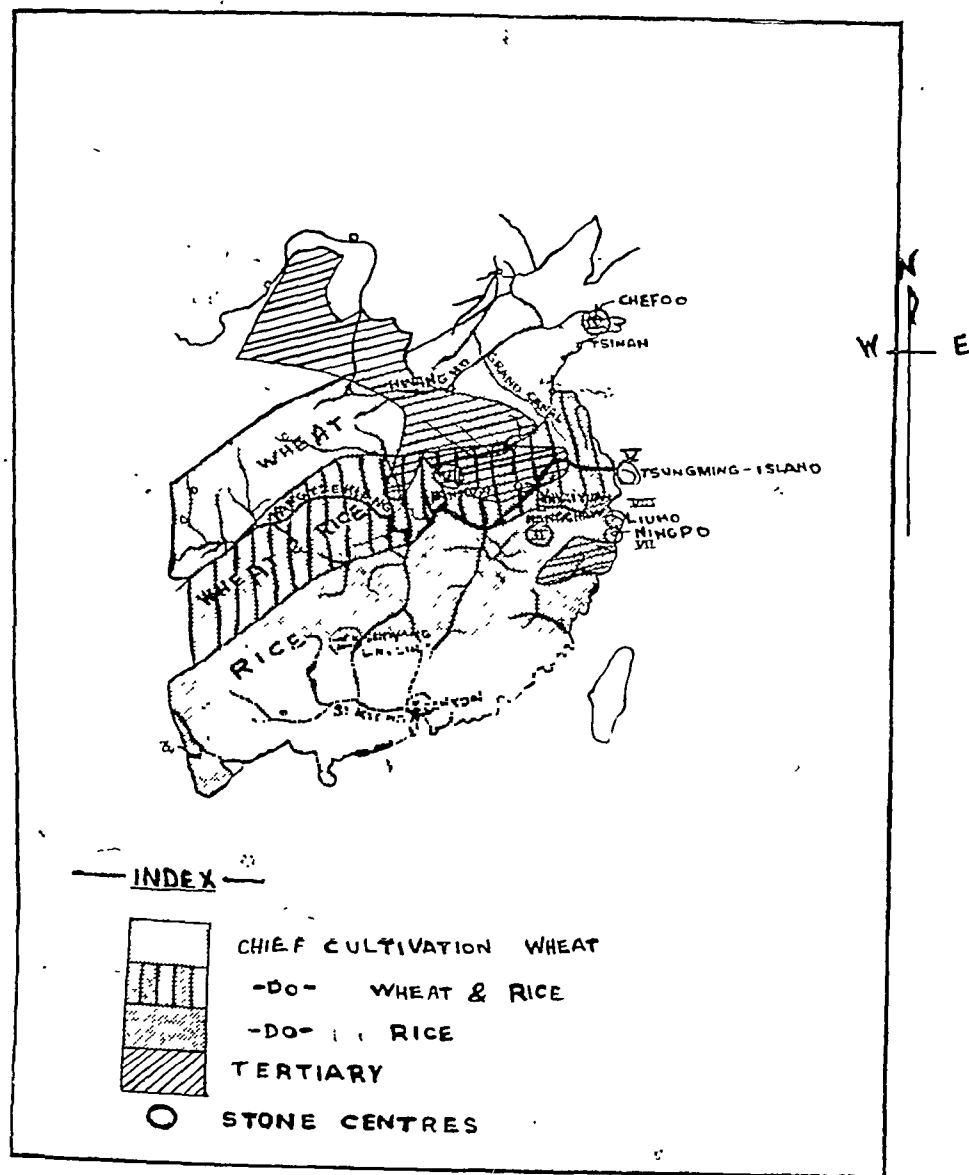
(2) In Shangtung province it covers the whole of the eastern part of the province probably centering in Chefoo with a second centre in Tsinan.

Small areas affected are :—

(1) In Hupeh mainly North-West of Hankow.

\*The author is indebted to the Govt. of Chung-king, China, for information about their country.

# MAP OF CHINA



- (2) In Chekiang in Ningpo district.
- (3) In Kiangsu near Linho.
- (4) In the Island of Tsungming.

Rare cases occur in:---

Kwansi, Fukien,

In the north & the west of China in Yunan and Manchuria.

The statement that Urinary stones are common in China is not quite true. In that country the disease is very common in certain areas and is rare in certain other parts.

Further minute study of a region is required to explain the exact geographical distribution and it was possible to do so with regard to our country.

## INCIDENCE OF STONE IN INDIA

References regarding the incidence of stone are made in the early Gazetteers of India, but the information is so scanty that it is not possible to draw even a vague map of the stone incidence of the time.

In 1894 at the first Indian Medical Conference Capt. Roberts read a paper on "*Vesical calculi in India*". The figures quoted by him are as under :—

Province.	Population in millions.	Annual stone operations.	Ratio of cases per 1000 of Population.
Punjab	19 Millions	1,482	0.078
N.W.F.P. & Oudh	45 "	925	0.017
Bombay	16½ "	283	0.017
C.P.	9¾ "	112	0.011
Bengal	69½ "	218	0.0034
Madras	31 "	21	0.00087
Assam	4¾ "	Nil	Nil

Robert McCarrison studied the same problem during the years 1926 to 1928. Some of his figures are as follows :—

## INCIDENCE OF URINARY STONES PER 1,00,000 OF THE POPULATION

India Generally	.. 10.
Dera Ghazi Khan (Punjab)	.. 438.
Hyderabad (Sind)	.. 266.
Sukkur (Sind)	.. 156.
Manipur (Assam)	.. 84.
Dera Ismail Khan (N.W.F.P.)	.. 62.
Sharanpur (U.P.)	.. 25.
Ahmadnagar (Lower Bombay)	.. 13.
Benares (U.P.)	.. 5.
Sylhet (Assam)	.. 2.8
Malabar (Madras)	.. 0.3
Kolaba (Lower Bombay)	.. 0

In the present work, the incidence of urinary stone was studied per 100,000 of the population of each district in British India.

Areas or Districts.	Incidence per 1,00,000 of the population
Northern & North-East Punjab, Western Half of U. P. and some districts in the South of U. P., Quetta, Ahmedabad, West Khandesh, Poona, Jubbulpore, Calcutta, Chittagong and Manipur.	10 to 25
Most of Southern Punjab on the left bank of Indus and Simla. Most of SIND on the right bank of Indus. Kohat & Peshawar in N.W.F.P., Jhansi in U.P. Nasik in Bombay.	25 to 50
Dadu and Tharparkar in Sind.	50 to 75
Sukkur in Sind.	75 to 100
Dera Gazi Khan in N.W.F.P.	
Dera Ismail Khan in N.W.F.P. Hyderabad in Sind.	More than 100

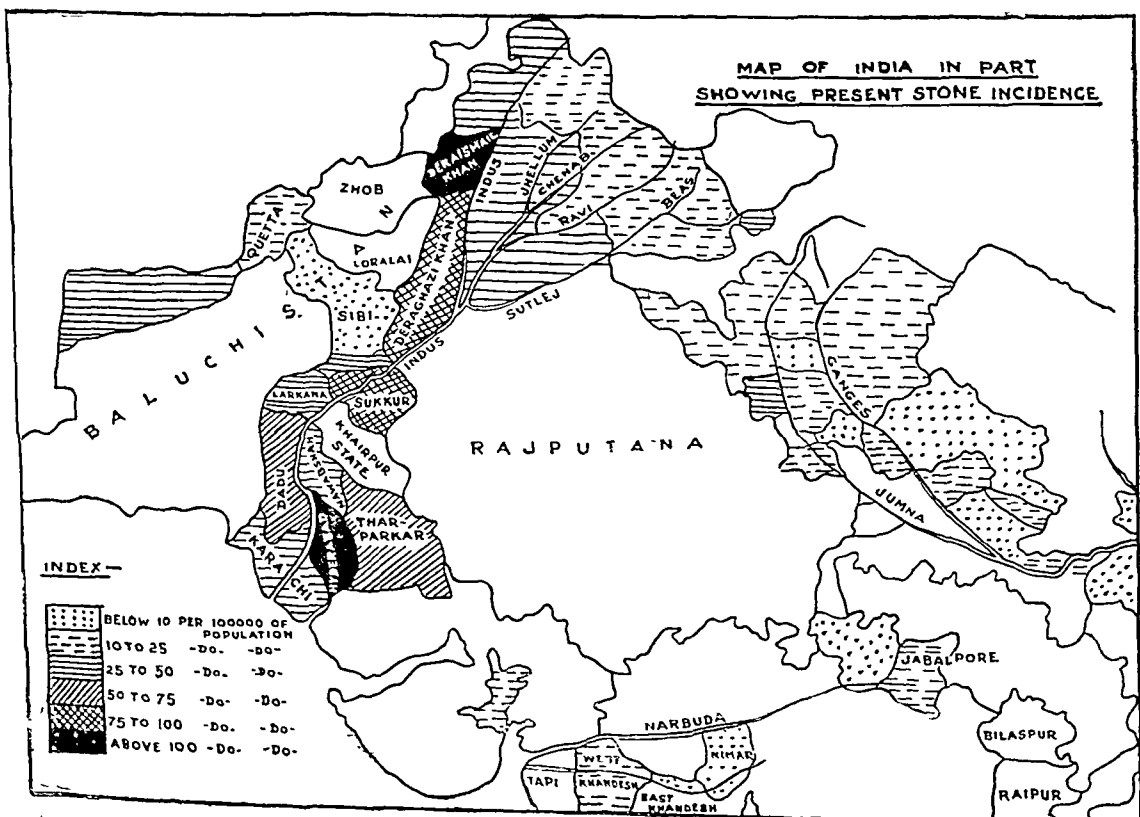
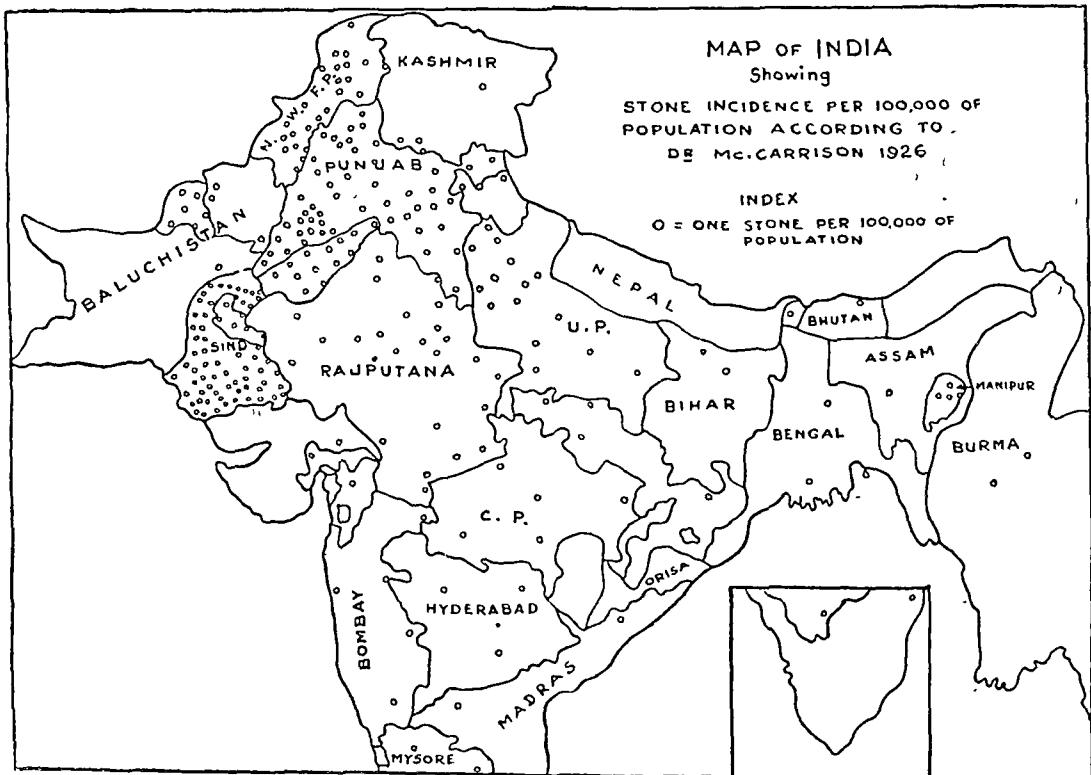
The present figures, the figures for 1894 and those of 1926 look quite confusing. Special maps were drawn for each of the periods stated above showing provinces where the incidence of urinary stone was maximum, where it was moderate and where the incidence was minimum. The maps for 1894, 1926 and the present show a close resemblance. If these maps could have been drawn for the districts or for the natural divisions of India as against political administrative boundaries, the three maps would be exact copies of each other. The few variations seen in the three maps are mainly due to variations in political boundaries.

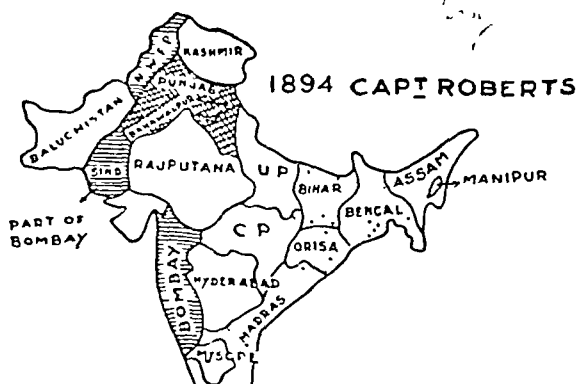
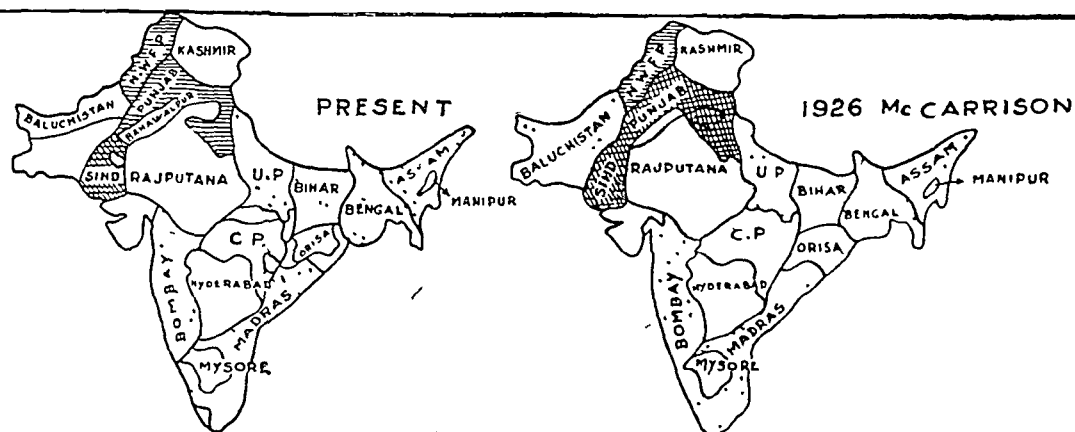
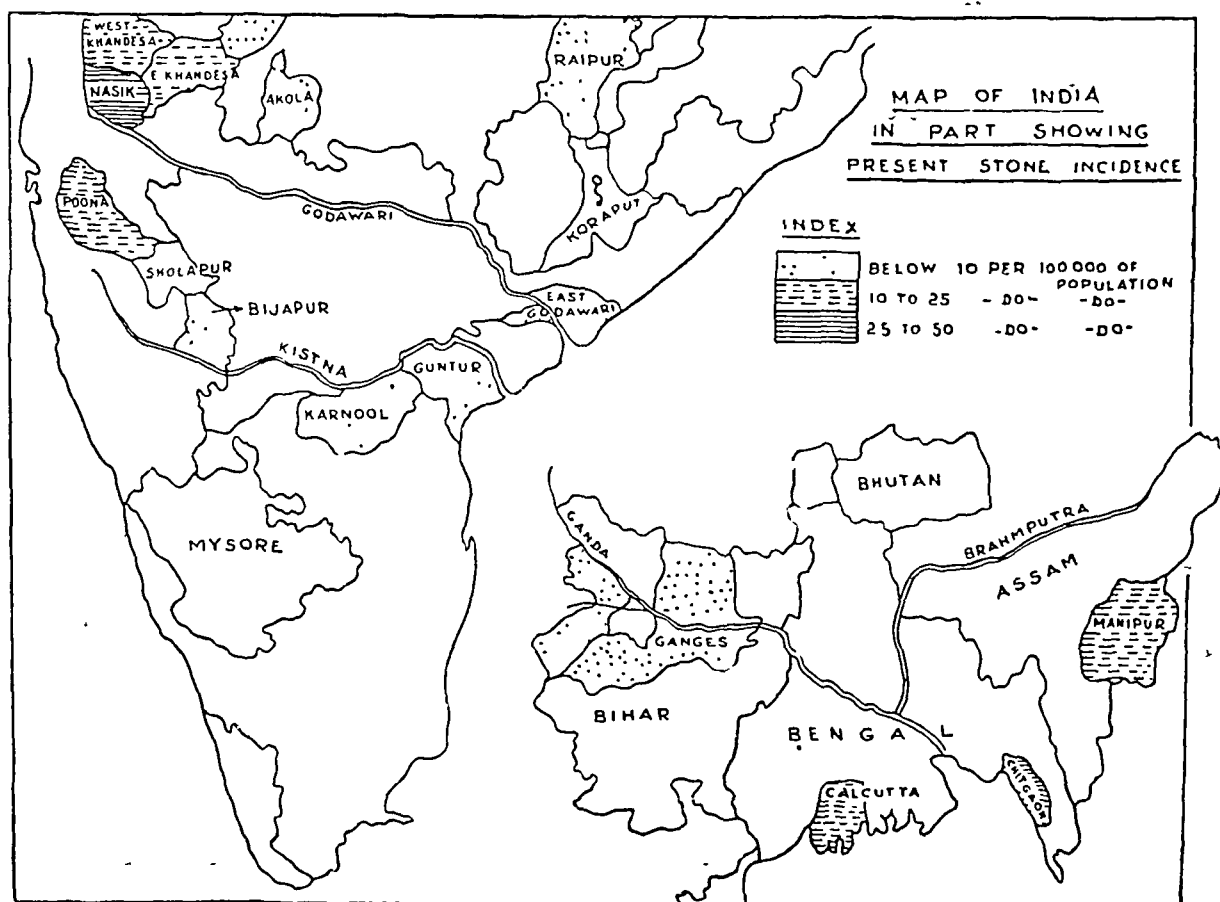
This almost unchanged variation of incidence from one region to another must have some explanation. There is reason to believe that the map of the world showing areas where urinary calculi are common has also remained unchanged.

Attempts to reason out this peculiar Geographical distribution have been made by various workers.

## RACE AND RELIGION

That neither the race nor the religion, has any bearing on the problem is self-evident from the fact that the urinary stone map of the world covers parts of Asia, Europe, and Africa.





MAPS OF INDIA  
SHOWING  
COMPARISON OF STONE INCIDENCES

INDEX.

[Dotted pattern]	LOW INCIDENCE
[Horizontal lines]	MEDIUM - DO -
[Vertical lines]	MAXIMUM - DO -

## CLIMATE

A study of the temperature and rainfall maps of India also shows no resemblance to the map of stone incidence.

The district of Nasik with its most pleasant climate has the same incidence of stone as the district of Jacobabad in Sind which is the hottest spot in the whole of India. Parts of the Punjab where the annual rainfall is less than 20" have the same incidence of urinary calculi as Manipur in Assam where the annual rainfall is more than 80".

## VITAMINS

Robert McCarrison stressed the importance of Vit. A as a causative factor in Urinary Calculi. It is fairly certain that the deficiency of Vit. A leads to serious injury to the renal epithelium and this in its turn is probably a cause of the stone.

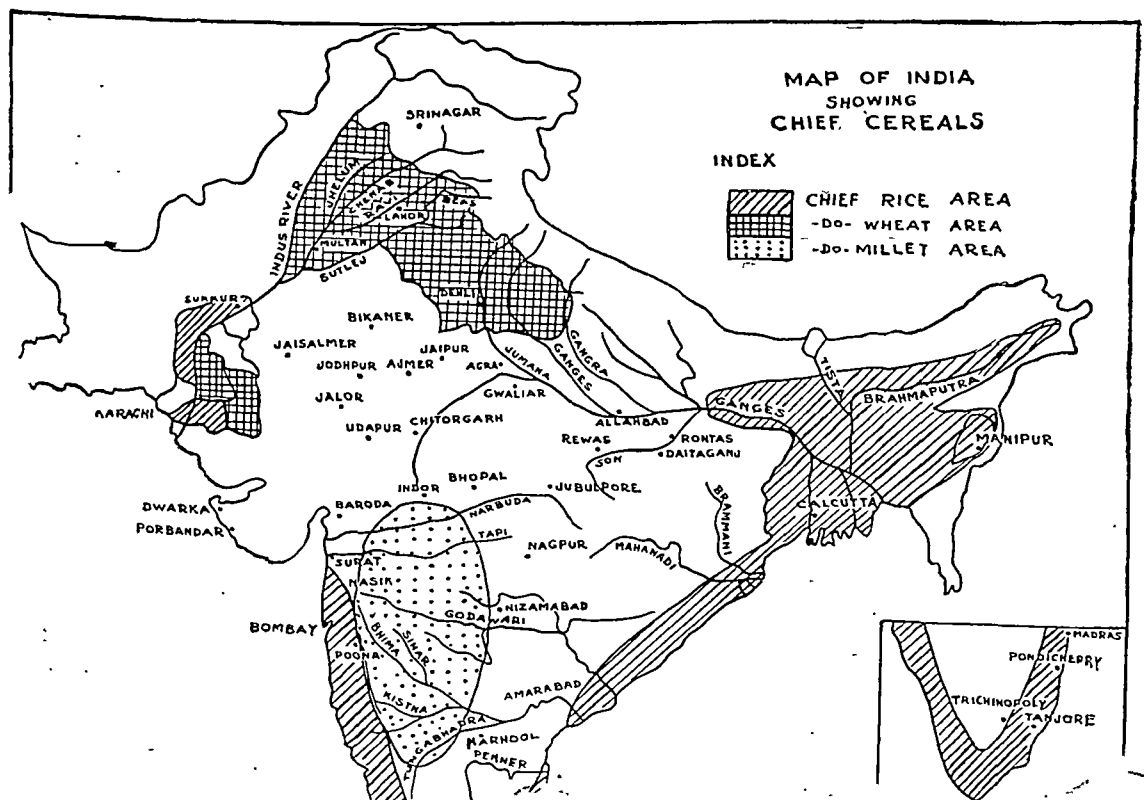
Sind and the Punjab are some of the most fertile provinces in India. Food and milk are plentiful there. The Hari or Farm worker in Sind by practice takes some milk every day. People from Madras and

the Deccan have a poor diet and do not take milk. Yet, strangely enough, the incidence of urinary calculi in the Deccan and Madras is insignificant as compared to that in Sind and the Punjab.

## CEREALS

Both Capt. Roberts in 1894 and Robert McCarrison in 1926 tried to prove that the cereals have a definite co-relation to the incidence of urinary stones in a given area. With the aid of figures available at the time Capt. Roberts showed that the incidence of urinary stone is in inverse proportion to the percentage of the rice eating population of an area.

Province.	% of population eating rice.	Incidence of stone per 100,000 of population
Punjab	5	7.8
N.W.F.P. & Oudh	8.8	2.1
Bombay	12.0	1.7
C.P.	30.0	1.1
Bengal with Bihar	61.0	0.34
Madras	30.0	0.067
Bengal without Bihar	61.0	0.04



It is unfortunate that the data for Sind and Assam were not available. The figures are convincing excepting for the omissions mentioned above.

McCarrison studied the same problem and found that in experiments on Albino rats, cereals showed a definite stone-producing tendency. He arranged cereals in the following order of descending stone producing potency.

1. Whole wheat flour.
2. Oatmeal.
3. Bajra.
4. White flour.
5. Rice
6. Cambu.

According to their stone producing potency, Capt. Roberts also arranged the cereals in the same order viz. wheat, millet and rice.

A study of the composition of the cereals regarding their calorific value, proteins, carbohydrates, fats and vitamins cannot explain the above order. Figures about the ash contents of these cereals are, however, interesting:—

	K	Na.	Ca.	Mg.	P <sub>2</sub> O <sub>5</sub>	SO <sub>4</sub>	Chloride	SiO <sub>2</sub>
Wheat	24.03	9.55	3.5	13.24	16.87	0.01	0.0	8.28
Rice	20.83	13.98	4.48	9.6	43.21	0.24	0.8	6.14
Oats	15.01	4.38	4.09	7.18	24.34	0.48	1.02	42.64

Comparing the figures we find that wheat contains more of K, Mg. than oats or rice and rice contains the same factors more than oats. Of the three cereals, rice stands highest in sodium content followed by wheat, oats coming last. In the chloride and sulphate content oats come first, rice comes second and wheat is third.

It becomes apparent that the alkaline ash and deficiency of sulphate, chlorides and sodium determine the stone producing potency of cereals.

The above analysis suggests that oats should have less stone producing potency than rice and rice less than wheat. Oats are not used as the main food cereal in any part of India and as such the stone producing potency of oats in comparison

to rice may have to be confirmed again by experiments on rats.

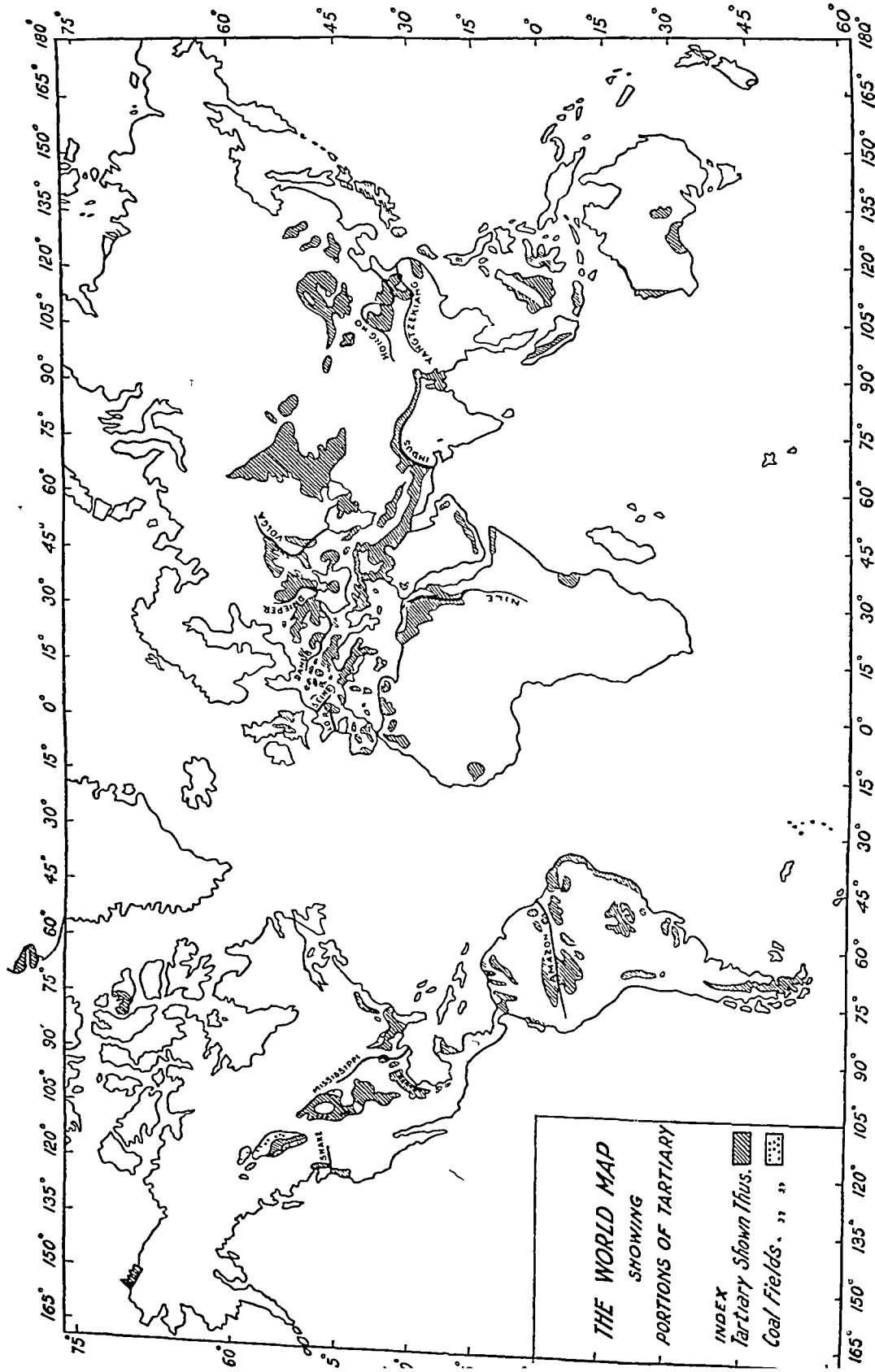
However, cereals and vitamins cannot explain the distribution of stone cases in India. The inhabitants of Manipur (Assam) are chiefly rice eaters and yet they have the same stone incidence as the people in Northern Punjab or Western U. P. where people are chiefly wheat eaters. On the right bank of the river Indus in Sind and in the Distt. Hyderabad (Sind) the chief crop is rice and yet the incidence of stone is very high being highest in the world in the Hyderabad distt. of Sind. In the Distt. Nasik of Bombay Presidency the chief cereal is millet and yet the incidence of stone is fairly high being nearly as much as in Southern Punjab.

It is almost a rule that farmers eat what they grow. The cereal map of India shows no resemblance to the map of stone incidence in India. In the same way the cereal map of China also shows no resemblance to the urinary stone map of that country.

Robert McCarrison showed on Albino rats that the millet of Northern India is more stone producing than the millet of Southern India. This variation in the stone producing potency of a single type of cereal must be depending on the soil of the region and its chemical composition.

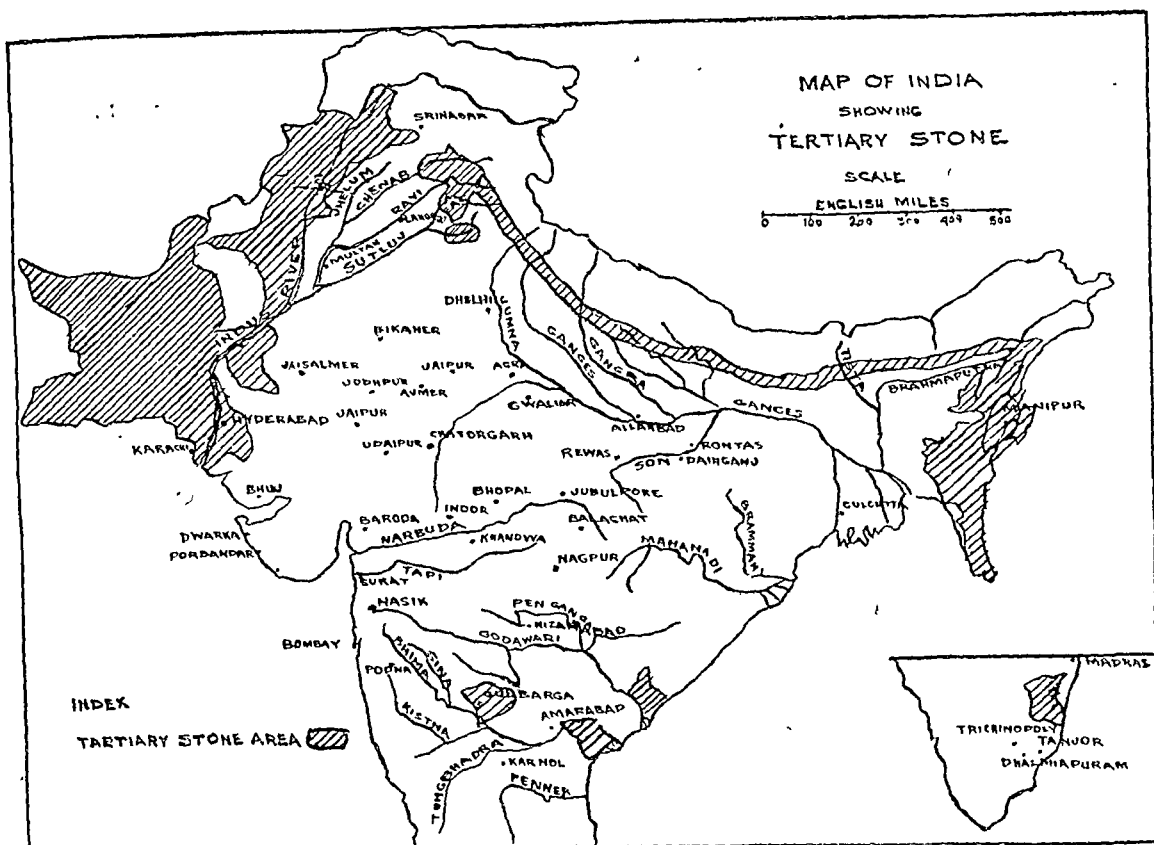
In Johannesburg (South Africa) the native population do not suffer from urinary stones whereas in the white population, the tendency is tolerably frequent. V. Vermootan is of the opinion that this is explained by the fact that the native South African lives on a simple, staple, stable and uniform diet rich in Vit. A, and having an acid ash basis and very low calcium content. The uneducated, badly housed, ill-fed, ill-treated South African native would not appreciate the above explanation as it is highly improbable that his poor diet could possess all the above merits. Poor people eat what they grow and the reason for the South African native not getting stones must be sought for in the soil and the earth of the region.

Soil is generally residual and is derived to a great extent from the rocks or the









geology of the area. Along the big rivers as in the Indo-Gangetic plain the soil is typical drift soil, transported by the river from the mountains.

### GEOLOGICAL ASPECTS.

A survey of the geological map of the world shows that the distribution of the tertiary rocks is comparable to the map of the frequency of urinary calculi in the world. There are, however, places where even with big areas of tertiary rocks (e.g. Urals in Russia) the incidence of urinary stone is not noticeable. Till recent times the Urals were not much populated and no information about the present stone incidence of the area is available. It is the combination of big river and tertiary area that goes to produce the increased incidence of urinary stones. A detailed study of the tertiary rock maps of India and China shows the same fact more vividly.

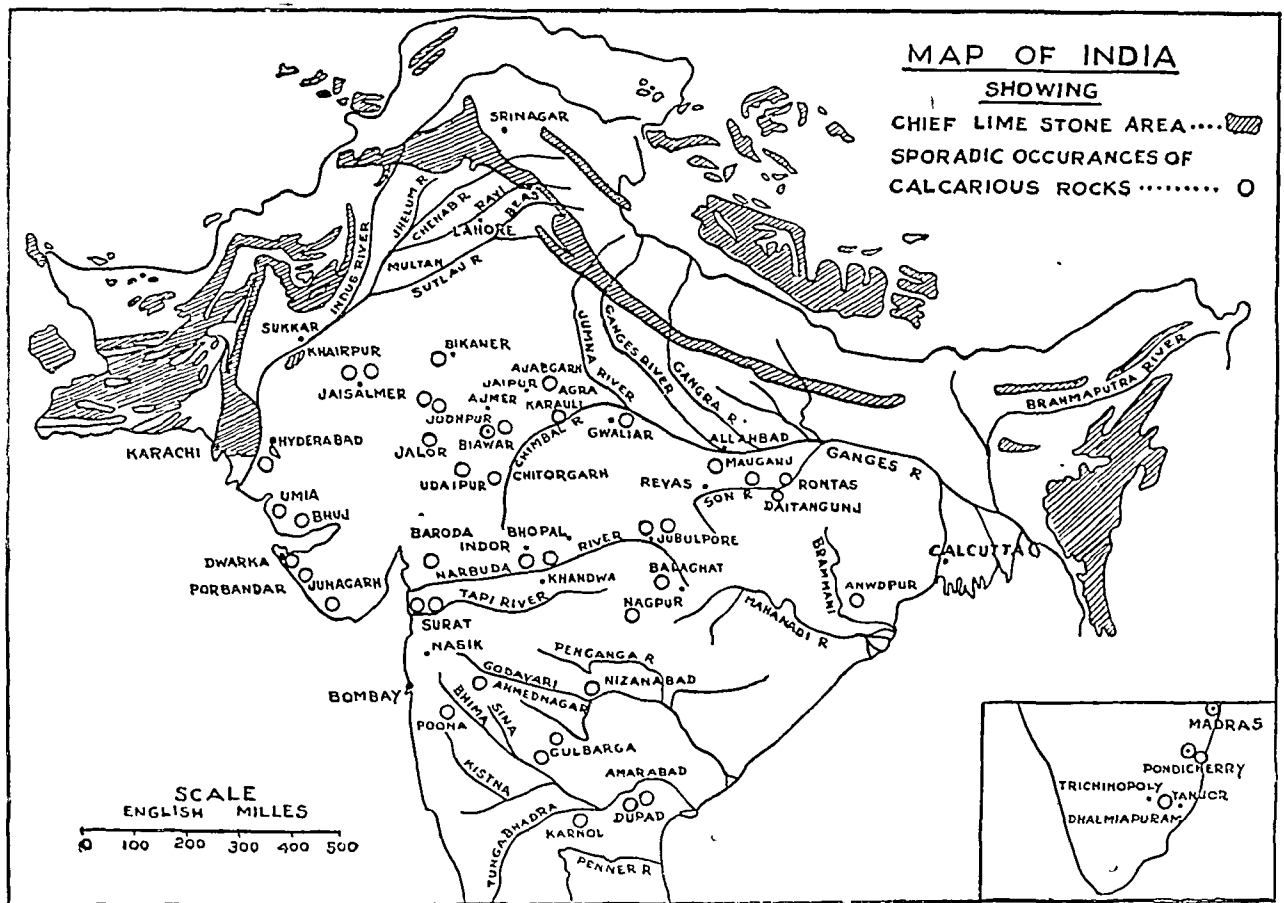
### TERTIARY ROCK AREAS.

The term tertiary rocks denotes rocks formed under water in the third stage or

period of time in the earth's history. The term does not give a definite idea of the chemical composition of the rocks but one thing is certain and that is that the tertiary rocks are usually rich in Calcium.

### AREAS OF INDIA CONTAINING CALCIUM.

The tertiaries are sedimentary rocks usually rich in Calcium. Some volcanic or igneous rocks also contain deposits of Calcium but they are not denoted in the map of Calcium distribution of India. Hence the areas not shown as "Calcareous" are not necessarily devoid of calcium. The map does not indicate the variety of the calcareous rock. The solubility of the deposit is a variable factor. A big calcareous deposit may consist of hard limestone dissolving with great difficulty, whereas small patches of Kankar may contaminate the water to a great extent as is evidenced by wells in Jhimpir in Sind. Therefore so long as the solubility of the different deposits is not studied it is useless to differentiate them on the map. In the



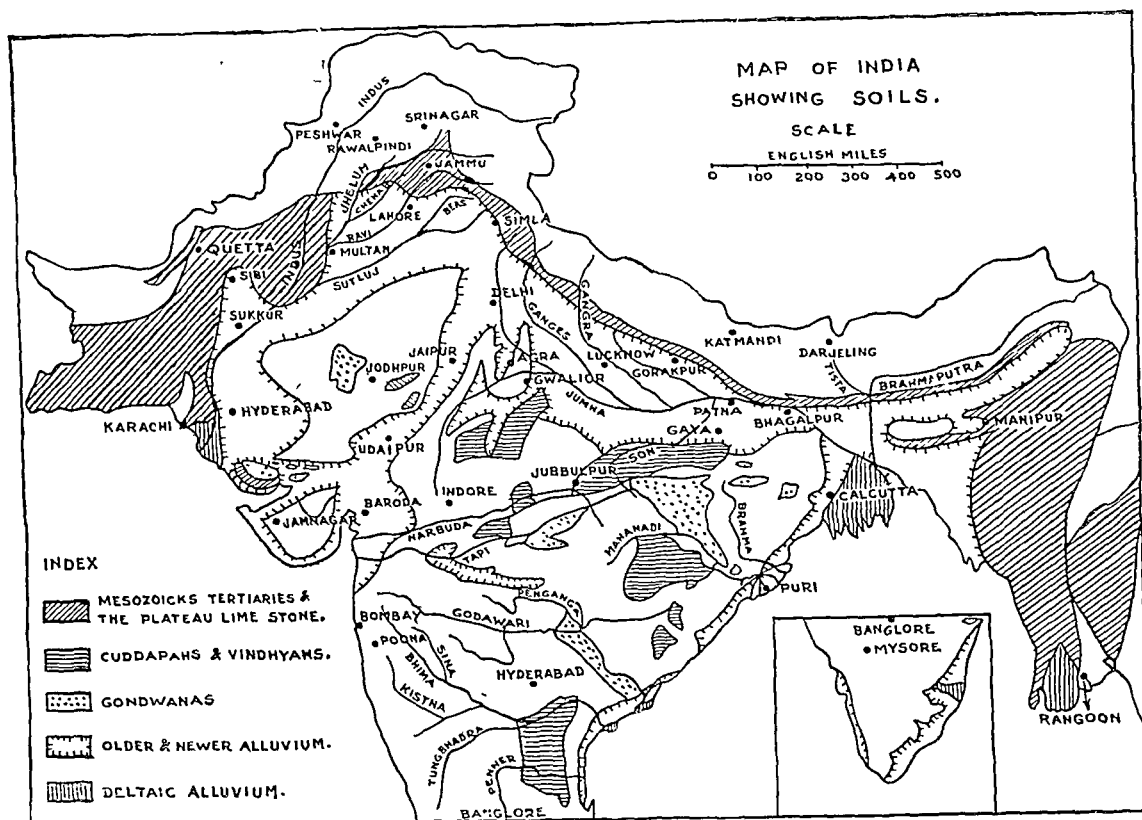
Rajputana desert there are concentrations of calcareous patches. These are derived from the resolution and recrystallisation of the calcium containing small, but innumerable, shells which are blown from the sea along with the desert sand. These patches at times are sufficiently calcareous to give effervescence with dilute Hydrochloric acid. Recent coastal deposits, also contain what is known as Littoral Limestone. These deposits though too small to be shown on any Geological map are nevertheless significant for the present investigation.

The most outstanding Calcareous areas however are those from the tertiary rocks. They are extensive in Sind, Baluchistan, North West Frontier Province, North West and North East districts of the Punjab, North West part of U. P., Manipur and an area extending South to Chittagong in Assam. The tract described is a continuous one from west to east connected by a tertiary calcareous fringe along the Southern borders of the Himalayas.

In a study of the incidence of Urinary stone, figures from the big cities are misleading. Due to the facilities of big hospitals, cases from all over the province tend to come to these centres and thus lead to apparent increase in the incidence of urinary stones in cities.

In such an extensive area of India as that which includes the Eastern United Province, Bihar, Orissa, Bengal and Assam it is only the Manipur, Chittagong, area which has any urinary stone incidence where it is in the range of 10 to 25 per 1,00,000 of the population. Other populated districts show hardly any stone incidence. There are hills in Assam rich in Calcium with hardly any population and as such without any urinary stone incidence.

Comparing the two maps of India, one of urinary stone incidence and the other of calcium distribution, certain outstanding features become noticeable. Dera Gazi Khan on the right bank of the river Indus is rich in Calcium. Distt. Muzafargarh



facing Dera Gazi Khan on the opposite bank of the river is a calcium poor area. The difference in the incidence of urinary stone in these two districts is great. Calcium rich Dera Gazi Khan has an incidence of 76 per 1,00,000 of the population while the calcium poor district of Muza-fargarh has an incidence of 45 per 1,00,000 of the population. To the South of the Dera Gazi Khan district of the Punjab comes the upper Sind Frontier District of Sind with Jacobabad as its district centre. This district is poor in calcium and its calculus incidence figure is less than half that of Dera Gazi Khan. On the West of Dera Gazi Khan is Distt. Sibi of Baluchistan. Distt. Sibi in the soil map of India is non-calcareous. There is no big river flowing through it and therefore the stone incidence is lower.

In the South, districts containing Calcium deposits also happen to be the districts showing more urinary stone incidence, e.g. Nasik, Gulbarga (Hyderabad State).

A map of urinary stone incidence drawn by McCarrison<sup>11</sup> closely resembles the one of calcium distribution.

Even in known calcareous areas the incidence of urinary stone is variable. As full details regarding the solubility and chemistry of the rocks are not available, these variations are expected.

In England, Norfolk is in the tertiary area rich in Calcium and has always shown high incidence of urinary stones. Calcareous areas of Westmoreland and Derbyshire also show definite incidence of urinary stones.

With the above reasoning, the immunity of the Johannesburg native from urinary stones can be well-understood as South Africa has no tertiaries and is probably poor in Calcium.

The above facts show that in a given area the regions which are calcareous and which have large rivers are the ones which show more stone incidence than the surrounding parts.

## CARRIAGE OF STONE PRODUCING ELEMENTS.

The urinary stone incidence map along the banks of the great rivers Indus and Ganges is suggestive of the fact that water carries the stone producing factor of calcium. The Ganges and the Jumna in their upper reaches, during their course in the western United Provinces, run through rich calcareous tertiary areas. As these rivers Ganges and Jumna go eastwards, they pass through non-calcareous regions. Some of the tributaries of the Jumna-Ganges system pass through the older rocks of the Peninsular block and carry little calcium into the valley. It is seen that the incidence of urinary stone between the Ganges and Jumna rivers falls as the rivers travel east. It is probable that in the non-calcareous area the river is slowly depleted of its calcium or the urinary calculus producing factor. In the south of the United Provinces some districts show high figures of urinary stone incidence due to local calcareous pockets as seen in the soil map of India.

The river Indus has rich calcareous tertiary rocks on its right bank all through its course from the source to the mouth. The incidence of urinary stone on the right bank of the river has varied according to the quantity and quality of the calcareous rocks. Regions on the left bank of the river Indus are not so calcareous as those on the right bank. Along the left bank of the river the incidence of urinary stone increases as the river goes southwards. Thus, Northern Punjab has less urinary stone incidence than Southern Punjab; Southern Punjab has less than Northern Sind (Sukkur) and Northern Sind (Sukkur) has less than Southern Sind, Hyderabad. Probably as the Indus river is continuously supplied with calcium from its right bank, the river becomes richer in Calcium, or stone producing factor, towards its mouth.

As the mighty river plays such an important role in the production of urinary calculi, the effects of the Sukkur Barrage on the incidence of urinary calculi are worth studying.

## EFFECTS OF THE SUKKUR BARRAGE ON THE INCIDENCE OF URINARY CALCULI

Figures of cases from Civil Hospital, Hyderabad (Sind) were available and are quoted below :—

1925	..	564	Annual average incidence 482.
1926	..	507	
1927	..	511	
1928	..	472	
1929	..	450	
1930	..	445	
1931	..	473	
1932	..	440	
*1933	..	492	*Sukkur barrage starts functioning
1934	..	577	
1935	..	553	Annual average incidence 653.
1936	..	856	
1937	..	733	
1938	..	709	
1939	..	709	
1940	..	1112	Average 745.
1941	..	589	
1942	..	537	

The latest census report shows an increase of the population by 14%. Even allowing 5 or 6% extra increase for local factors such as a good or a bad surgeon coming to the district, the average number of stone cases treated annually should not have grown beyond 600. One thing is certain that, inspite of the extra water made available due to the Barrage, the incidence of Urinary stones shows no tendency to fall. The words 'probable rise' are avoided deliberately as all sorts of explanations such as better knowledge, increased medical facilities, better transport, etc., could be advanced to explain the rise in the stone incidence of the district.

## WATER ANALYSIS.

An analysis of the water of the various regions is the crux of the whole problem. Figures of water analysis are quite confusing and as such figures of hardness alone are given below. Of the sulphates and carbonates of calcium in water sulphates are less likely to be absorbed in the alimentary canal than the carbonates. The Bicarbonates give water its temporary hardness and are more important in causing urinary stones.

Region.	Temporary hardness of water.	Incidence of stone per 1,00,000 of the population
Trichinopoly	0	0
Coimbatore	0.5	10 to 25
Moradabad	12.0	
Lucknow	9.0	
Delhi	6.0	
Poona	7.0	
Karachi	12.0	25 to 50
Jacobabad	20.0	
Larkana	10.0	
Shikarpur	14.0	
		75 to 100

The above figures are not very convincing as the proportion of the incidence of urinary stone and that of temporary hardness of water is not mathematical. Figures of water analysis of a particular province are far more convincing.

#### WATER ANALYSIS IN TOWNS OF THE UNITED PROVINCES

Town.	Temporary Hardness	Incidence of stone in the area
Cawnpore ..	4.	3.
Meerut ..	4.	8.
Allahabad ..	6.	4.
Benares ..	7.	13.
Agra ..	7.	14.8
Lucknow ..	11.	15.5
Aligarh ..	13.	15.0
Moradabad ..	13.	21.0

Thus the incidence of urinary stone is higher where the temporary hardness of water is greater.

In Bihar the same thing is observed.

Town	Temporary Hardness	Stone incidence
Muzzaffarpur.	20.0	3.
Bhagalpur ..	7.5	5.
Gaya ..	6.6	6.
Patna ..	14.0	13.

It appears to be a foregone conclusion that temporary hardness of water is a definite cause of urinary stones.

Hamilton Bailly states "Old beliefs die hard and it will be a surprise to many to learn that urinary calculi have little or no connection with hard water and excessive perspiration."

With the evidence produced above such a statement must be considered wrong.

In the present work some studies were made regarding the acid radicals taking part in the formation of urinary stone.

The percentage of uric acid in urine at various ages is different as given below :

Age in days	% of uric acid in urine
1 .. ..	0.18%
2 .. ..	0.24%
4 .. ..	1.5% (Baby died of Jaundice)
5 .. ..	0.4%
6 .. ..	0.37%
7 .. ..	0.21%
9 .. ..	0.42%

Age in years	% of uric acid in urine
1½ ..	0.153%
2 ..	0.152%
3 ..	0.142%
8 ..	0.097%
9 ..	0.095%

Age Group	% of the uric acid in urine.
15 to 20	.. 0.08%
20 to 25	.. 0.075%
25 to 30	.. 0.060%
30 to 35	.. 0.060%
35 to 40	.. 0.062%
40 to 60	.. 0.075%

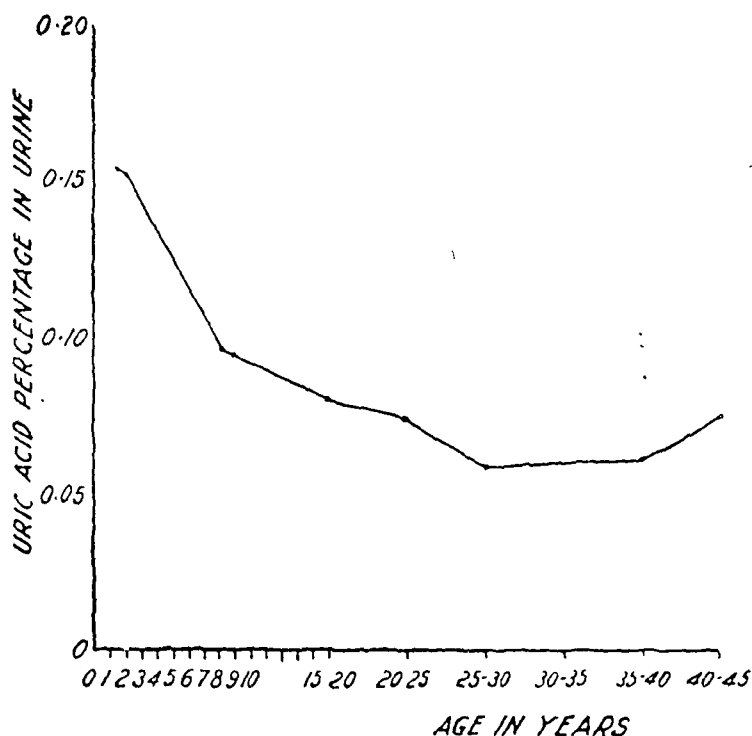
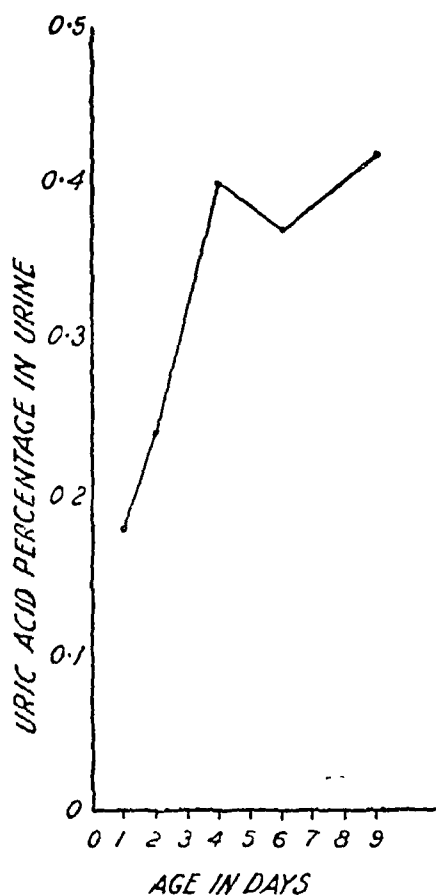
It is observed that the urinary uric acid is very high in infancy, rapidly falls during childhood, remains almost steady in adult age and tends to increase again in old age.

The figures for urinary uric acid percentage would suggest that uric acid and urate stones must be more common in children and it is so, as far as naked eye classification goes.

#### OXALIC ACID

Calcium oxalate in solution is precipitated immediately if the solution is made alkaline by any base, weak or strong, showing that in cases of oxaluria, the urine must be kept acid in order to prevent the formation of urinary stone.

It is stated in almost all text books that the crystals of oxalate, as seen under a microscope, are envelope-shaped or sometimes dumb-bell shaped. However, on a study of the various crystals of oxalates it was found that it is extremely difficult to have a crystal of Calcium Oxalate. The Calcium Oxalate looks more like amorphous particles. It is the Potassium oxalate crystal which is envelope-shaped and the crystals usually seen in the urine of an

GRAPH SHOWING PERCENTAGE  
OF URIC ACID WITH AGE

oxaluria patient, are always of Potassium never of Calcium.

### PHOSPHORIC ACID

Phosphaturia is usually evidenced by white urine. The white colour of the urine does not however mean that the urinary phosphates are increased quantitatively. It is often only the ammoniacal decomposition or the alkaline reaction of urine that gives the white colour to the urine. Even with white colour urinary phosphates may be normal or subnormal.

Vegetables, milk diet, alkaline mixture and excessive carbohydrates increase the urinary phosphates. An experiment on a student gave the following results:

	% of phosphate in the urine.
Normal diet (Vegetarian) ..	0.063%
Vegetables, milk, 2 chapaties and Bicarbonate of soda mixture.	
1st day ..	0.09%
2nd day ..	0.15%
3rd day ..	0.36%

The experimental food became nauseating and on the 4th day the Soda Bi Carb mixture was dropped.....0.15%.

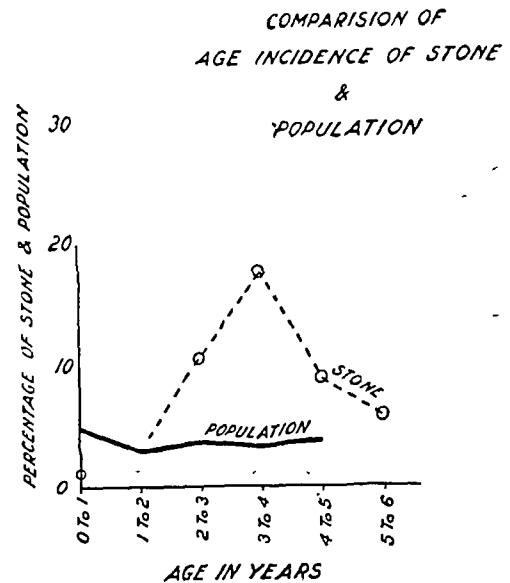
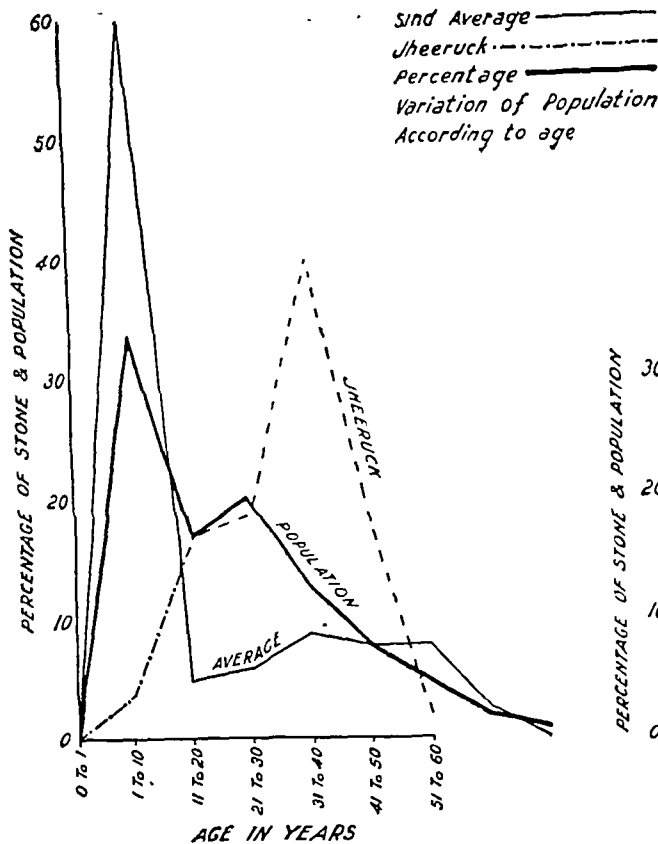
Basing the facts on the results of the experiment, it was surmised that it was the Bicarbonate of soda that was doing the greatest mischief. Alkalies and acids are relative terms and if Bi-carbonate of soda increases the urinary phosphates then deficiency or absence of hydrochloric acid in the stomach would do the same.

Fractional test meals done on a few cases of Phosphaturia showed that in all these, gastric hydrochloric acid was either deficient or absent. It is suggested that in all cases of Phosphaturia one should do gastric analysis and then treat them with acid hydrochlor. dil., if required, in preference to acid sodium phosphate.

Besides the commonly discussed salts of calcium, calcium sulphate is a fairly usual finding in the composition of urinary stones (Barium chloride test).

### AGE INCIDENCE

In India and China urinary stone is a disease seen mostly in children, and it



used to be the same in Europe a hundred years ago. Now, in Europe and in England, stone is not common in children. In India and China the general standard of health is poor and more so of children whose rate of mortality is very high. It is probable that the fall in the urinary stones among children in Europe is due to better conditions of health.

A study of the age incidence in districts of Sind showed that the percentage incidence of stone at each age period varies to a certain extent from district to district.

Age group.	Variation in % of stone incidence.	Average % of stone incidence.
Less than 1 year	0 to 3.5	1.1
1 to 10	42.8 to 67.0	59.0
10 to 20	1.5 to 6.	4.5
20 to 30	5.0 to 13.5	5.9
30 to 40	6.5 to 14.6	8.9
40 to 50	4.5 to 13.4	7.8
50 to 60	4.5 to 12.2	8.0
60 to 70	1.5 to 3.2	2.3
70 to 80	0.4 to 1.0	0.3
(Total No. of cases 1852)		

It is in the district of Larkana (Sind) that we get the higher figures in the older age groups.

Even in Sind itself figures from cases in Jheeruck dispensary are surprisingly different as can be seen from the following table :

Age Group.	% of stone case.
Below 1	0.
1 to 10	4.5
10 to 20	17.2
20 to 30	20.0
30 to 40	40.0
40 to 50	19.0
50 to 60	2.7
(Total No. of cases 115)	

Jheeruck is one of the health resorts in Sind and a tuberculosis sanatorium is located in the town.

#### INCIDENCE IN TOWNS AND VILLAGES

People in towns are said to get less urinary stones than those in the villages.



The following figures in this respect are interesting :—

District town.	% of the district population living in the town.	% of cases of stone coming from the town.
Hyderabad	17.6	8.3
Karachi	54.2	24.2
Larkana	5.4	8.7
Nawabshah	2.9	20.9
Jacobabad	6.7	20.8

It would be noticed that except in Karachi and Hyderabad the stone incidence is actually higher in the towns than in the rural population.

One of the possible causes of a lower stone incidence in the Karachi and Hyderabad city population may be the filtration and chlorination of water in these cities. Other towns in Sind have no such facility.

### MISCELLANEOUS

There are certain other facts regarding urinary stones which may be of importance. Whales in their natural state do not suffer from urinary stones as far as can be ascertained from scientific observers among whalers.

In the olden days it is said that sailors who used to eat mostly salted food were immune from urinary stones. The present day sailor has living conditions as if he is on a moving modern city. In the Jail records of Sind cases of urinary stone are almost unknown. The very few detected are among the new comers.

### SUMMARY AND CONCLUSIONS

1. The uriniferous tubule probably acts on the principle of a flush.

2. All deposits in the kidney which are insoluble, pigments and casts could be seeds of urinary stones.
3. Sodium, chlorides and sulphates, have the property of preventing the formation of urinary stones.
4. The Tertiary rock map of the world in association with the big rivers, resembles the map of distribution of urinary stones.
5. Scarcity or abundance of water has no effect on the incidence of urinary stones.
6. Temporary hardness of water is one of the most important causes of urinary stones.
7. The envelope-shaped crystals seen in oxaluria are of Potassium oxalate and not of calcium oxalate.
8. In cases of Phosphaturia, gastric analysis often shows achlorhydria or hypochlorhydria.
9. Calcium sulphate is a fairly common constituent of urinary stones.
10. Age incidence of urinary stones probably depends on the general standard of health and care of children.
11. Town people get more urinary stones (than the rural population) if the water is not chlorinated or filtered.
12. Whales, sailors of old days and long term jail inmates have no urinary stones.

I am grateful to Lt.-Col. Grey, Lt.-Col. Eminson, Dr. Aklani and Prof. Pithawalla for giving me every facility in collecting information.

## MALUNITED FRACTURES AND DISLOCATIONS\*

by T. H. SOMERVILL, F.R.C.S., Neyyoor, Travancore.

Fractures as described in text books are nearly always assumed to be recent, and the treatment for these is so adequately described in them, and probably so well known by most surgeons, that it would be an impertinence for me to repeat now what most operating surgeons already know so well.

But, as we all know, fractures as we meet with them in India, more especially in country districts, are not often brought to a surgeon or to a hospital at once, but are only too often submitted to our treatment weeks or months or even years later, having been first treated by local quacks, or neglected and allowed to unite in bad positions, or to show non-union, with stiff joints and other disastrous consequences, such as traumatic ossification, Volkmann's contracture, etc.

During the last 22 years, while at work in a large surgical centre in the extreme South of India, I have felt again and again the need for guidance in the treatment of such cases. The text books, even where they are right, can only remind us of general principles, and are of little or no value in the specific treatment of any particular case. In many ways, therefore, we have to feel our way through the treatment of a case, doing as best we can by the light of general principles and of such knowledge as we have gained from similar cases in the past. It is my hope that my own experience—often that of failure—in these cases may be of some value as guidance in the treatment of late and maltreated fractures and dislocations.

My only justification for writing this article is that I was working for 3 years (from 1918-21) under Sir R. Jones in Liverpool and Leeds, doing little else, but the correction of malunited bones and stiff joints, after which I came to India, and I have thus had a continued experience of this class of case extending over 25 years. Obviously in a short space a

complete account of this large subject cannot be given, but rather a series of hints as to what to do, and what to aim at, expressed largely in the form of notes for brevity's sake.

First we must remember *the general principles* of the treatment of fractures:

### A. ESSENTIAL:

1. Immobilisation, as absolute as the surgeon can make it by plaster or appliances, of the fractured ends. This must be continued until the fracture firmly unites, and not relaxed one day before this occurs. It must be combined with:
2. Free active (not passive) movement of all other joints from the earliest possible time, best of all from the day after the fracture (or, in late cases, the re-fracture, bone-graft, osteotomy, etc.)

### B. WHEN POSSIBLE:

3. Good apposition of fractured surfaces.
4. Good alignment of the two or more fragments of the bone or bones.

### C. WARNING:

5. Passive movement is almost always wrong, as is early massage except in some cases of nerve-involvement.

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*Note*—Some fractures heal well with free active movement even of the joints on either side of the fracture from the very beginning, e.g. A fracture of the upper end of the humerus, if resting on an abduction ("aeroplane") splint, properly applied, can be allowed to attempt movements of shoulder and elbow from the very first day. If he is prepared to undergo some pain, and the movements are always active and never passive, and if he is under the observation of the surgeon throughout the first two months, this treatment though theoretically unsound is very successful in producing ultimately a

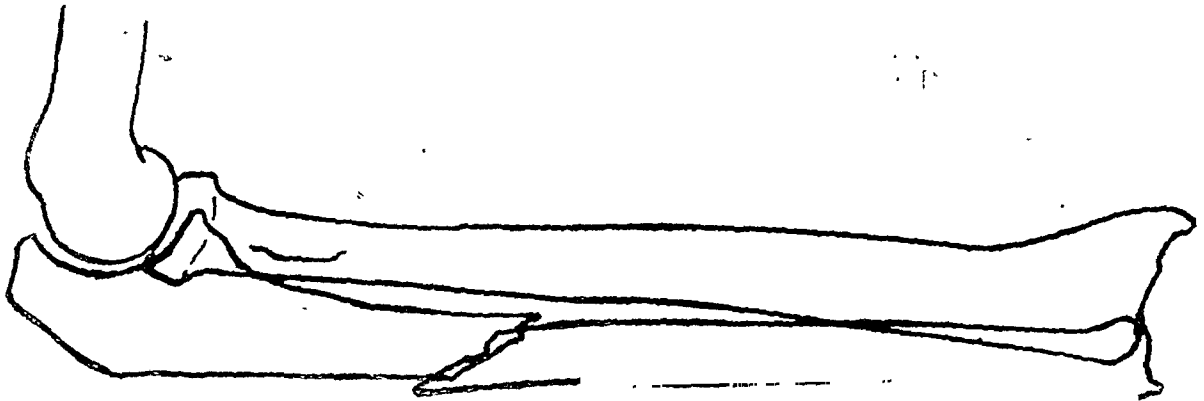
\* A paper read at meetings of the Delhi Medical Association on Oct. 6, and of the Travancore Medical Association, Nov. 4, 1944.

perfect functional result. Some cases of Pott's fracture show similar reaction to free movement from the very first. All "half-way houses" between this treatment by mobility and strict immobilisation are nearly always thoroughly unsatisfactory.

- (1) *Malunion, firmly united, of one bone.*  
*Shortening: Does not matter in hume-*

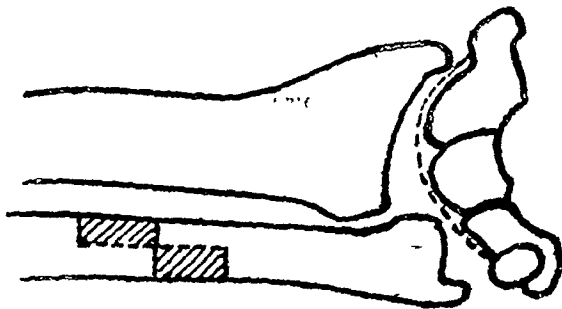
bone of the wrist joint, therefore shortening of it makes a bad wrist. If an ulna is shortened, and the elbow is stiff and painful, we have to think of excising the head of the radius, a simpler operation than lengthening the ulna, for lengthening of any bone is very difficult owing to the concomitant shortening of muscles, and the difficulty of excising scar tissue around

Fig. 1.

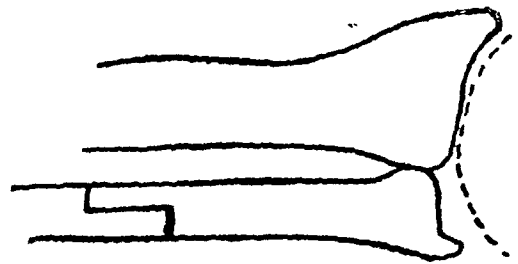


Shortening of ulna. Radius pressed up against capitellum. Painful elbow.  
 Treatment—excise head of radius.

Fig. 2.



I.



II.

Shortening of radius. Wrist radially deviated. Awkward hand movements.  
 Treatment—excise a piece from ulna as marked (I). Join together as II.

rus or femur up to 2 inches. Does matter in radius or ulna, not so much if both are involved. The ulna is the bone of the elbow joint, therefore shortening of it makes a bad elbow. The radius is the

the fracture, either of which may prevent the lengthening we should like to make. (Fig. 1).

Similarly if a radius is shortened, the ulna will project beyond it at the wrist, causing radial deviation of the wrist; a very crippling disability, for all wrists, if deviated at all, are stronger if deviated towards the ulnar side.

For these cases, excision of a piece of the ulna 1 or 2 inches above the wrist joint is the treatment of choice, the mortice-like ends being tied together with



III.

Alternative treatment of ulna, useful if inferior radio-ulnar joint is ankylosed.

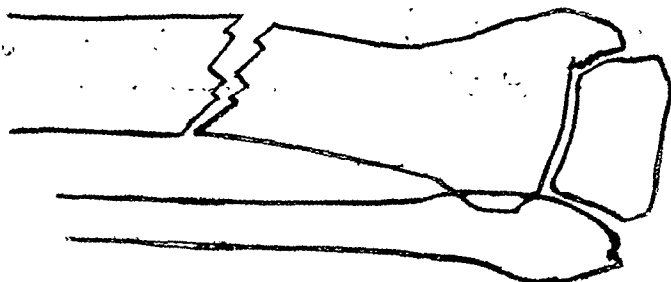
strong catgut or linen thread. Immobilisation must be complete, until the fracture is firmly united. (Fig. 2.).

In the tibia, shortening seldom takes place unless the fibula is also fractured; if it is, very great disability may result. But here the disability is usually one of *direction* rather than *length*. The tibia and fibula must be cut, and fixed in plaster with the foot in as nearly as possible the natural position, paying all regard to the *direction* of the bones, but not attempting any lengthening of them, and not necessarily getting the *alignment* perfect as long as perfect *direction* is maintained. (Fig. 3.).

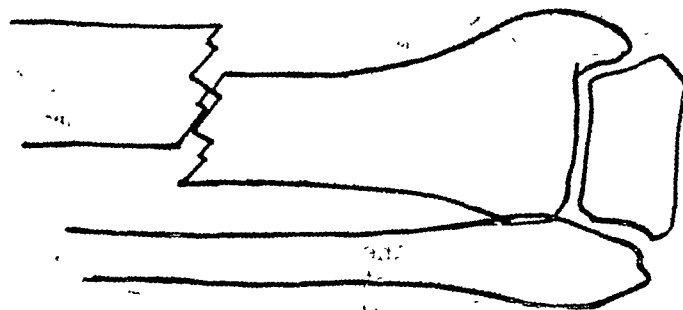
If there is great disability, look out for widening of ankle joint and undetected fracture of fibula. Correct this, and if it seems to be indicated refracture *os calcis*, and put Steinmann's pin in distal fragment with 1/6 or more of body-weight as extension. When callus formation is satisfactorily started, put in plaster including pin, foot in slight dorsiflexion, for at least 4 weeks. If dorsiflexion impossible, put in slight equinus position. X-rays important at all stages. Must be immobilised until it is healed. Weight-bearing allowed one month later.\*

(2) *Malunion of Direction or Alignment.*  
Mild degrees do not matter except

Fig. 3.



Bad position for tibia. Union is end to end but direction of lower fragment is wrong.



Better position. Direction is preserved. Foot will be in orthopaedically sound position

*Os Calcis.* Very often this is best left *uncorrected* if no great disability in walking is shown. Bone projecting near the external malleolus must be removed with a chisel enough to free the malleolus from contact with it during movements.

(a) *Radius and ulna.* Tendency to cross union. If shortening is not excessive, usually it is better to operate on one

\* In the discussion following this paper, there was a general opinion that *os calcis* is usually better left alone, if united, even in bad position.

bone—the worst—only, chiselling the ends to suitable shape—in fact doing a modified cuneiform osteotomy—and putting up in Plaster, usually best in full supination. Elbow to be included if upper ulna is involved, Wrist to be included if lower radius is the bone to be corrected by operation. All joints of fingers must be kept mobile.

(b) *Tibia and fibula.* By whatever means possible, the direction *must* be corrected, or walking will be painful.

(c) Upper and lower ends of femur. *Plating* is usually the best operation, as the forces concerned are so strong as to threaten breaking any graft except perhaps a whole-fibula graft. As soon as union is firm, the plate should be removed.

### (3) MALUNION OF ROTATION.

(a) *Radius or ulna.* Although the radius is the bone of rotation and the ulna merely the axis around which it rotates, if a fracture has been set so that rotation is limited or painful, *either bone* may be at fault, ulna just as often as radius. If there is difficulty to pronate, it is probably due to the fracture having been set in full supination. The ulna is more accessible, and the operation on it less disturbing to muscles etc., so it is usually the bone to be operated if it has been fractured either alone or with the radius, and the hand must be held in full pronation by an assistant while the ends of the bone are levelled and wired. Splint for a few days, then plaster in full pronation. The wire should be taken out, a window being cut in the plaster for this purpose, about 2 weeks later, and the plaster left on till union is firm. Typists must be able to pronate, others prefer ability to supinate for eating purposes. If there is difficulty to supinate, the operation must be finished on the bone, and the hand put up in plaster, in full supination.

(b) *Neck of femur.* May be ununited or malunited. If ununited, Smith Peterson pin. (Methods in text books). If malunited, open operation, osteotomy, and either Steinmann or Peterson pin, better the latter. *But* remember, the latter is a serious operation with its own risks of

stiffness or other disability afterwards, and should only be done if disability of rotation is really crippling—not merely to correct a slight inconvenience. Wherever possible osteotomy if required should be trochanteric. If the head of the femur is absorbed or fragmented, Whitman's or MacMurrays, or some similar operation (see textbooks) may have to be done.

(c) *Humerus.* Some degree of torsion of the humerus is tolerable to the patient, but I have seen two cases in which there was inability to rotate the humerus sufficiently to use the elbow properly, and osteotomy, with support of the arm on an aeroplane splint, had to be done. The elbow must be moved every day to the fullest possible extent, while the arm rests on the splint. This splint, or plaster with arm abducted and elbow bent, will keep the humerus in the mid-rotated position.

(d) *Old compound fractures with sequestra.* If there is no great orthopaedic disability, these must be treated by radical removal of all sequestra, the spaces left being filled with muscle grafts. These grafts must be sewn into position (best by a silk-worm gut stitch through the end of the graft tied on the skin opposite—beware of penetrating arteries or nerves, especially in the leg), for it will be necessary to keep up the movement of joints, and this is apt to pull the graft out of the hole which it fills. If a simple orthopaedic operation is required, such as correction of the alignment of the long bone, this may be done before the sequestrectomy wound has been healed for any length of time, unlike bonegrafts or operations involving introduction of plates or wires, which must not be done until 6 months after healing. If sepsis is not as serious a consideration as time, the orthopaedic operation may be performed earlier\* (of course unless a bonegraft be involved). In this type of case, free use of Sulphathiazol powder mixed with Proflavine, at the time of operation, is advisable. Immobilisation heals the sepsis as well as uniting the fracture.

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\* I have done several of these cases successfully, while the sequestrectomy wound was still discharging pus, but when only one infecting organism could be found.

(e) *Non-union of bone.* This is nearly always due to failure to immobilise the fracture. Even in cases up to six months old, a good plaster with real immobilisation may effect union, for the hyperaemia of the bones which causes decalcification is no longer stimulated by movements; ischaemia and sclerosis is soon produced, and the fracture will have the chance, which it has never had before, of uniting. Immobilisation depends on the prevention of *all* movements of the two fragments on one another. Plaster if used, must adequately prevent such movements as the following:—

(1) *Radius and ulna.* Pronation and supination in the forearm may occur and cause non-union if the plaster be not carried above the elbow, and made to include the wrist (but not the fingers).

(2) *Humerus.* Rotation will occur if the plaster does not include the shoulder joint in some form of spica; the plaster should extend to the wrist-joint.

(3) *Carpal Scaphoid.* Plaster must encase the wrist on both sides as well as above and below, to stop all flexion, extension, adduction and abduction of the wrist—these latter movements hinder

union of the scaphoid. Fingers must be free to move.

(4) *Neck of femur.* Plaster cannot prevent some movement of the loose femoral head; only a Peterson Pin can do that. Alternatively, conversion of an adduction of the femur to abduction by a trans-trochanteric osteotomy will produce a tendency to impact, and therefore to remain relatively immobile and unite. (Fig. 4).

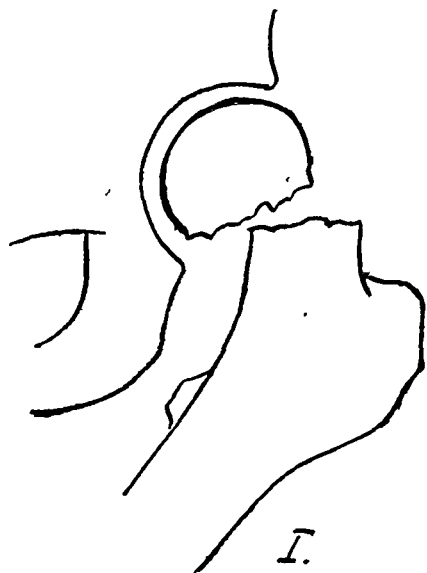
(5) *Femur (shaft).* Usually requires a plate or graft, as it is difficult to immobilise by other methods. Plates *always* get loose in a few weeks, before union is firm; hence external splinting or plaster is imperative until radiography shows that the bone has actually healed.

(6) *Tibia.* Must not be allowed to rotate; plaster must include foot up to roots of toes, and knee must be bent, plaster going well above it to the groin.

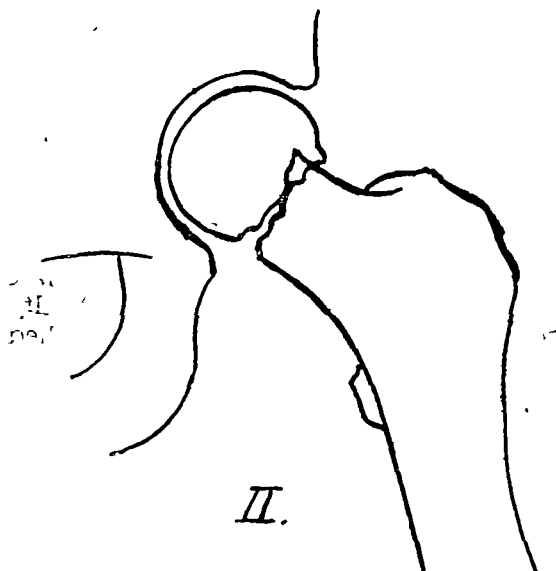
(7) Non-union in the upper fibula, the upper radius, or the lower ulna may be of no great importance and lead to little or no disability.

If the bones have not got sclerosed ends, union is always theoretically obtainable.

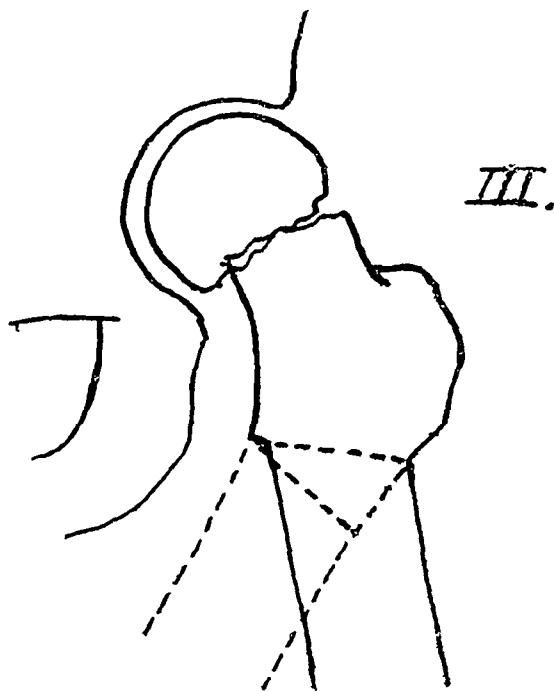
Fig. 4.



Adduction fracture (unstable).



Abduction fracture (stable).



Adduction fracture converted to stable abduction position by cuneiform osteotomy.

If the ends are sclerosed in ununited fractures, union can *never* take place, and drilling of the bone-ends with multiple holes, or better a bone grafting operation, is indicated.

Points to be noted in bone grafting are mainly the following:—

- (1) The graft must be large enough to be strong, and the cut-away of bone must be large enough to open up cellular spaces and marrow.
- (2) The graft must fit tightly into both bones so as to allow no movement.
- (3) It must be rectangular, an inlaid graft being nearly always the best. Pegs in medulla are to be avoided when possible as they block the active living marrow from access to the area for repair.
- (4) Grafting must never be done until a septic fracture has been firmly healed for at least 6 months.
- (5) No foreign bodies such as wires should be introduced, if they can be avoided, to fix the graft in position.
- (6) Plaster of Paris must be unpadding and keep the bone immobile while

allowing all joint movement that is possible consistent with absolute immobility of the bone.

- (7) The graft must in my opinion be autogenous, other bones such as ivory pegs, beef bone etc., being always inferior. It should be taken and put in at one sitting.

*Involvement of a joint.* We now approach the most difficult cases, those of uncorrected dislocations, and fractures involving joints which have become stiff, or painful, or ankylosed. These cases present many problems so difficult that we must all confess to having had many failures among them. Each one is different and has to be studied as an entity; but there are certain general lines along which we must go in the treatment of all.

(A) *Maltreated and unreduced dislocations without fracture.*

*Shoulder.* This is nearly always anteriorly dislocated, and operation is best done through an incision along the posterior border of the anterior axillary fold. The vessels and nerves are defined, and gently held out of the way.

There will be much scar tissue, which should be removed. The capsule will probably be unidentifiable except in a recent case (under 1 month). The field of injury must be cleared until the humerus can be easily put into its proper position in the glenoid cavity. The clavicular origin of the deltoid may have to be detached. There are two alternatives then, one of which must be done; if not, the dislocation will certainly recur, unless the shoulder is so stiff as to permit no movement worth speaking of:—

(1) A posterior incision along the posterior border of the deltoid must then be made, and  $\frac{1}{4}$  to  $\frac{1}{3}$  of the deltoid removed from its insertion; this is passed through the quadrilateral space and sewn tightly with linen thread to the acromion process. After one week or less, movement of the joint must be started, almost entirely active not passive.

(2) *Alternatively*, Nicola's operation should be done; this operation consists in the cutting of the tendon of the long head

of the biceps and its fixation through a tunnel made with a  $\frac{1}{4}$ " drill through the outer part of the head of the humerus. This avoids a second incision. For method see textbooks.

*Elbow.* Here we have a very difficult type of case. An elbow dislocated for more than 3 weeks cannot be said to be a satisfactory case. It cannot be reduced by manipulation; if reduced by operation the great majority of cases become very stiff indeed in their movements, and some get completely ankylosed. There are three possible courses of treatment:—

(1) If there is a fair range of movement without pain, it is probably best to do nothing.

(2) If movement is limited or painful, some surgeons advise the forcible bending of the elbow, which nearly always fractures the olecranon. The arm is then splinted in flexion, and the olecranon either becomes a sesamoid bone in the triceps tendon, or can be removed by operation two or three weeks later. This procedure had the approval of no less an authority than Sir Robert Jones.

(3) Operative attempt to restore the joint. Preliminary excision of the head of the radius must be done through an anterior incision. The second operation is done within 3 weeks, by a posterior incision. The radial nerve must be continually borne in mind. The olecranon process must be sawn off with the attached triceps, and turned up. Scar tissue should be removed until the articular surfaces of the ulna and humerus and the olecranon fossa are exposed, and these *must not be damaged* by the operation in the course of exposure.

(A) If after doing this the bones will articulate together without tendency to dislocate, they may be left in position, and the wound closed. The after treatment is:

(1) Active movement from the first if the joint is not easily dislocated otherwise; if it is;—

(2) Firm splinting in plaster for 2 to 3 weeks from shoulder to wrist, followed by active movement. On no account must passive movement or massage be em-

ployed. The prognosis of this conservative operation is not good, but a few cases do very well. Most others have to have a secondary arthroplasty some months later.

(B) If the position is felt to be unsatisfactory, the only thing to do is to do an arthroplasty in the right arm, or to aim at ankylosis at 135 or 140° in the left (writers, 110°, and so on according to the profession of the patient).

*Wrist.* Dislocation of the wrist is uncommon without fracture, especially in falls from trees, or extreme violence, and if there is much pain, stiffness or ankylosis, the wrist will probably have to be fixed to the *radius*, every effort being made to preserve the rotation of the radius round the ulna. The wrist must be fixed by a bone graft, from radius to the os magnum and any other carpal bones that may be convenient; if possible *including the 2nd metacarpal* (better than the 3rd, as a little ulnar deviation, as well as some slight dorsiflexion of the wrist, gives the ideal position). On no account should there be radial deviation, nor palmar flexion, in the final position.

The operation for choice should be done from the *dorsal (extensor) surface* of the hand, owing to the reliability of many tendons (and not just 1 or 2) to become adherent to the scar if operation is done on the flexor side. If pronation and supination cannot be obtained through ankylosis of the lower radius to the ulna, an inch from the lower quarter of the ulna may have to be removed in order to obtain the requisite mobility, which it is very desirable to preserve if the wrist itself is to be ankylosed. (Other complications are frequent but cannot be dealt with here; such are adherence of tendons, comminution of ends of bones and presence of sequestra).

*Hip.* Dislocations of long standing are usually best untreated, unless pain or disability are very great. Attempts at reposition are very unsuccessful, and apt to be followed by osteoarthritis and great pain, necessitating further ankylosis, or arthroplasty, or MacMurray's operation, or if the dislocation recurs, Lorenz's bifurcation osteotomy. Hence if treatment is called for, it is best to perform arthro-



plasty or arthrodesis as the first operation. The question of which to perform is a matter for the opinion and skill of the surgeon. In nearly all operations on the hip just the best incision is anterior J. shaped (Smith Peterson) with removal of the great trochanter and displacement upwards of the Gluteus medius muscle, the tensor fasciae being drawn forwards. Even for a backward dislocation this gives the best and most bloodless access to the joint.

*Knee.* Dislocations are very rare as a result of injury, but common due to contracture of the hamstring muscles, and to long-standing (or rather—sitting!) flexion of the knee, kept flexed by the patient because extension is painful or difficult.

The best treatment in bad cases is arthrodesis. In cases with paralysis of the quadriceps, it is the only treatment. It must be performed by sawing the ends off both femur and tibia, with a sliding bone graft to reinforce the operation, as the lower end of femur and upper end of tibia, however skilfully shaped so as to be adherent together, are notoriously difficult to persuade to unite by bone and not by fibrous union. In slighter (sub-uxated) cases, Steinmann pin in the tibia 3" from the upper end may be used to pull the tibia gradually into a workable position, and exercises with *active* extension instituted as soon as possible.

*Ankle.* Dislocation without fracture is uncommon, but when it occurs is usually posterior. It is nearly always accompanied by a separation of the lower ends of tibia and fibula with fracture either of fibula or of the internal malleolus. In a late case operation will certainly be required. After reduction (with excision of all scar tissue interfering with the joint itself), the tibia and fibula will probably have to be screwed together, either with an external or internal screw. A Bone screw is best, or vitallum. This must be inserted far enough from the ankle joint to avoid danger of causing arthritis. It must be taken out as soon as the fracture if any is united. If the patient can bear the pain, the fullest possible (active) movement from the first day after the operation gives the best chance of recovery.

The alternative treatment is absolute immobilisation for 6 weeks or until union occurs.

(6) *Involvement of a joint in a fracture*, including fracture-dislocation.

*Shoulder.* The details of operation on the bone vary from case to case. The important thing is that there should be no projection at the upper end of the head of the humerus. After reduction of the dislocation as already described, the arm must be put on an aeroplane splint, but not fastened to it except at night; the patient must be encouraged to move the arm off the splint if possible, even if only for 1/8 inch, and if he is able to do this in 3 weeks, the prognosis is good. Wrist, elbow, etc., must of course be moved freely from the beginning.

*Elbow.* Here are seen our most difficult and varied cases, owing to the frequency of periosteal new bone, and of traumatic ossification around the joint. Preliminary faradic treatment of the flexors and extensors of the elbow and also often of the forearm muscles, is nearly always a good thing, and is essential for several weeks in cases whose elbows have been immovable for many months or years. In addition to bony and joint injury, there is often some degree of Volkmann's contracture, which makes the case still more difficult to treat. This will be dealt with later. In the absence of actual dislocation, the chief principles to be borne in mind are:—

(1) Good Radiographs A. P. & L. are essential.

(2) The movement of the joint may be limited either by adhesions, or by a bony block; this latter, if it be *only* limiting flexion and on the flexor surface of the humerus, must be removed. This is best done by an anterior incision on the ulnar side of the bone, so that all vessels and nerves except the radial can be defined and avoided. Limitation to extension by bone or fibrous tissue in the olecranon fossa must be similarly dealt with by a posterior incision. This can be extended if necessary so that by suitable retraction either of the condyles and the whole joint can be explored. Fragments of condyles usually can be left in situ. Sometimes a

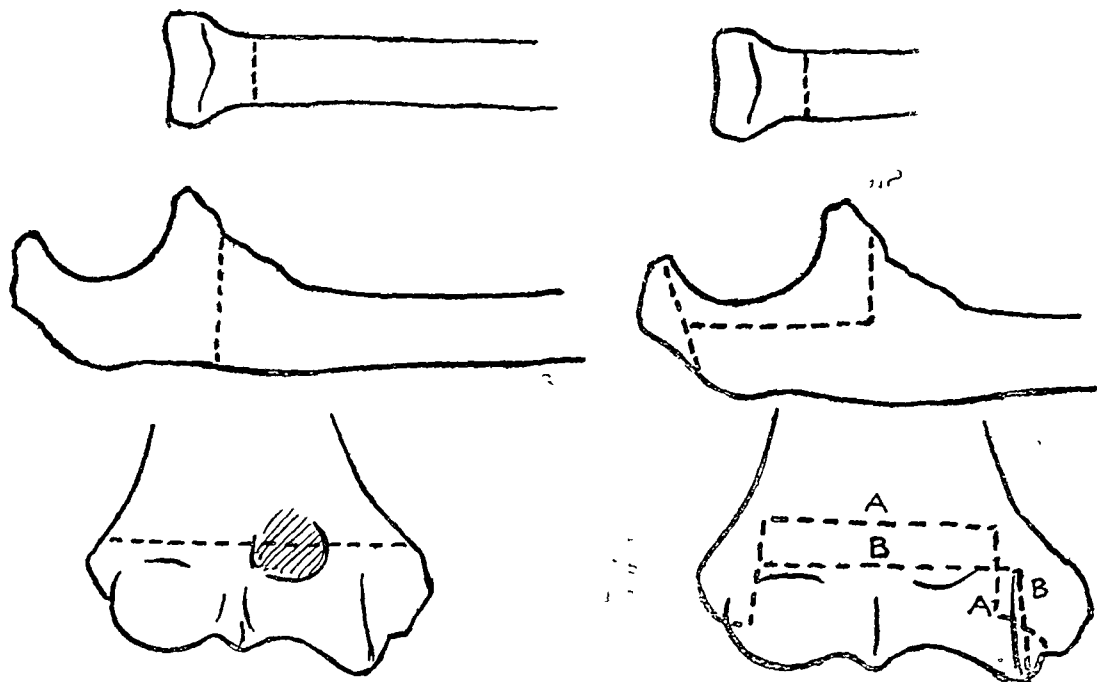
fragment of capitellum is in the joint cavity, and must be removed. If after tidying up the joint, so to speak, good movement is obtained, the limb is splinted at right angles for 2 days, and then put up in unpadded plaster at the corrected position in *semipronation*.

If good movement is still not obtained, the head of the radius must be excised before the operation wound is closed. The patient is to lie in bed with the bent arm arranged so that the humerus is vertical and an extension of the weight of the arm *plus* 2 lb. is put on; on the third day (i.e., when all bleeding has stopped): Immobilise for 14 to 17 days, then start active movements. The plaster being removed by cutting along radial and ulnar borders along its whole length; half the plaster is used as a splint and firmly bandaged on when the arm is at rest.

More grave damage than can be dealt with by the operation just mentioned may call for either excision (arthroplasty) of the joint, or arthrodesis, according to the patient's profession, and the relative utility of a weaker movable joint and a strong fixed one. (Fig. 5.)

Besides the textbook arthroplasty with fascia lata grafts over all the bone-ends involved, it is possible to dispense with these. The arm is subjected to no extension for 3 days, after which it is extended by 1, 2 and 3 lbs. on 3 successive days, kept at 3 or 4 lbs. for 2 weeks, then the extension is reduced to 2 lbs. for 2 days and 1 lb. for 2 days. Next day the supported arm is bent to 90° by the patient. Active movements are then started, the arm being kept in a sling bandaged to the side when not in use. This treatment is no good for an excision of elbow; bones must be cut as in ordi-

Fig. 5.



**Excision:**—Split the triceps and preserve its insertion into the fascia covering the forearm muscles.

Splint at right angles or less for 18 to 20 days, then active movements.

**Arthroplasty:**—Reflect the triceps with the olecranon, replacing this after the operation with catgut sutures.

Splint straight out for 1 or 2 weeks, then at right angles for 2 weeks or less; extension about 2 lbs.

Then do active movements.

A gives greater stability to the joint;

B gives freer movement.

nary arthroplasty. The advantage of this method is—it is less likely to go septic, owing to the operation being shorter and less complicated. Disadvantage is that about one third of the cases are unsuccessful and finally ankylose.

The chief principle in this as in other arthroplasties is—*remove plenty of bone*; what is apparently too much removal is probably about right. Penicillin if obtainable is very useful as a prophylactic—mixed with Sulphathiazole powder, it is left in the joint cavity; alternatively, Sulphothiazole with 2% of proflavine and 5% Sod. Bicarb.

*Wrist.* Has already been dealt with.

*Hip.* Arthroplasty is better not done unless both hips are involved. Arthrodesis at 150° gives a useful joint but necessitates the use of a commode afterwards. (For osteotomies Lorenz's, MacMurray's, etc., see text books).

*Knee.* Aim at arthrodesis at 150° to 160°.

*Ankle.* In bad fractures, arthrodesis may have to be aimed at, in which case the calcaneus must be united to the talus, as well as the talus to the tibia and navicular.

*Vertebrae.* Old fractured vertebrae are generally met with as compression fractures; months or years after the fracture the body of the vertebra may start absorbing and collapsing into a wedge-shape. If untreated at this stage, further collapse and angulation is likely to take place, and the wedge may be forced backwards so as to compress the cord and cause nervous symptoms. It is when these have already started that most patients seek surgical relief. I have dealt with a large number of these cases here, and am convinced that a decompression laminectomy is the treatment of choice, following by a plaster in lordosis, applied by the methods described by Boehler or Watson Jones, and kept on for 4 months. In cases with but little evidence of nervous lesions, plaster alone can be tried; but if the nervous lesion is not relieved at all in 3 months, decompression laminectomy is indicated.

*Patella:—*

(1) *Ununited.* It is usually best, if the fragments are widely separated, to excise

them and repair the retracted quadriceps tendon with fascial sutures from the fascia lata. The stitches must be drawn as tight as possible and the leg put up in plaster in full extension for 8 weeks.

(2) *Adherent to femur.* Excise the patella, and free adhesions of the quadriceps tendon to the femur, by bending the knee to a right angle. Then suture the quadriceps with fascial strips, covering the hole in the joint, left by the patella, as far as possible. Immobilise for 3 weeks in full extension, and then take off plaster and allow active movement. Recovery of movement should be complete in 3 to 6 months. This treatment is simpler and more reliable than arthroplasty with fascial graft between patella and femur.

*Volkman's contracture.* Never try tendon lengthening. Adhesions and stiffness are almost invariable sequelae. The only two operations possible are:—

(1) *Shortening of radius and ulna.* Must be morticed and wired, so as to render them firm, or plaster will have to be applied so long as to make treatment impossible for many days; so it is better to do the following:—

(2) Detachment of all involved muscles from their origin, this being allowed to slide down the ulna and radius until new attachments are formed at a suitable level. During this operation the median nerve can be freed from adhesions and compression between the two heads of the pronator teres.

*Stiff fingers.* The numerous different appliances that have been devised for the relief of this common and serious disability are themselves an indication of the great difficulty of treating these. Boehler advocates a stitch through the pad of each figure-tip fastened to a spring extension, the other end fastened to an adjustable or malleable metal (soft iron wire) racket, attached by plaster to the wrist.

Massage, our enemy in so many conditions, may be our friend here. Hot baths (114° F. for ½ hour followed by active and very gentle passive movements) are sometimes useful. Occasionally movement under anaesthetic,—another thing to be avoided in almost all other joint

conditions due to injury,—is beneficial, but must never be done more than once, and must be followed at once by active movements, aided by faradic stimulation. This latter is useful in all cases as a preliminary to the surgical treatment of joints; as ankylosis or immobility for many months causes degeneration of all muscles, and renders the patient incapable of doing those active movements which are our sheet anchor in the after-treatment of these cases.

### A FINAL WORD

Fractures heal much more soundly and rapidly in a healthy body. This means that as much exercise and movement as possible of all parts of the body (except

the bone or joint actually fixed by plints or plaster) must be undertaken.

Good food, ample vitamins (especially C and D), and extra calcium are advisable.

In a patient whose fractures unite slowly, Liq. Aluminum Acetate is a useful adjuvant to firm union, taken 4 times a day for 2 or 3 months.

In old compound fractures, the possible lighting up of old sepsis and even of tetanus must be remembered; proflavine and sulphathiazole powder is a good prophylactic, used freely in the operation wound, and allowed to remain and be sewn up inside the wound.

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## “AN ADDITIONAL TEST HELPING IN THE DIAGNOSIS OF CHRONIC CHOLECYSTITIS”

by R. B. CAPT. K. S. NIGAM, M.D., F.R.C.S., D.T.M.,  
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It is now universally believed that a diseased Gall bladder is one of the most frequent organic causes of chronic dyspnoea.

Of the pathological states of the Gall bladder that which mostly concerns the practitioner is cholecystitis and that too chronic. It is a slow, smouldering chronic inflammatory change affecting the wall of the Gall bladder. The cause is infection through the systemic circulation in the vast majority of cases. The prevailing belief is that *B. Coli* from intestinal lesions or streptococci from the throat gain entrance into circulation, pass from lymphatics, veins, heart and then via the hepatic and cystic arteries, get implanted into the deeper layers of the Gall bladder wall. There they set up chronic fibroblastic response ultimately damaging the structure to such an extent that it loses its physiological function of concentrating bile to one tenth of its volume and to add

mucus to it and aid in the absorption of cholesterol from bile and perhaps excrete it on occasions. Further effects are reflex gastric symptoms of vague distention, pains in the upper abdomen specially after dinner and flatulence. This is explained by the fact that both Gall bladder and stomach are supplied by the nerves partly from the vagus and partly from sympathetic related to the ninth dorsal segment of the cord. The focus of internal sepsis thus established in the Gall bladder may react injuriously by toxic absorption on the cardiac muscle and the body generally. Very frequently this disease is associated with a recurrent or chronic Appendicitis and inflammation or ulceration of Pyloro-Duodenal region forming with them the abdominal triad of diseased Gall bladder-Pyloro-Duodenal region and the appendix. The vascular and Lymphatic connections of these three regions are closely associated.

While trying to investigate thoroughly the Biochemistry of blood in cases of diseased Gall bladder in our Wards and Surgical Research Laboratory we came across a unique experience, that is, the sufferers from chronic cholecystitis show marked cholesterol retention on doing what we call *cholesterol tolerance test*.

The estimation of cholesterol in blood falls into two categories, in one the whole blood is taken and the amount estimated while in the other case the cholesterol is estimated in the separated plasma. In India the work was carried out by Major T. C. Boyd and A. C. Roy (1929). They estimated the blood cholesterol of 100 cases and found the minimum value of 82 mgm. and the maximum 184 mgm., the average coming to 116 mgm. In other countries many workers have worked on this and their values are decidedly higher than those found here. Robinson in 1929 (Lancet) gives the average value of 151 for whole blood and 142 for the plasma. Gardner estimated by Digitonin method and gives the figure of 169 mgm. as average of 43 cases. The figures given by Wester and Kent are the highest. They give the average value as 182 in their 52 cases. The figures were ranging between 117-297 mgm. In our work we have estimated the cholesterol in separated serum; the colorimetric method was employed for this. Cases were taken from the wards. The estimation was done in most of the cases on empty stomach in order to eliminate the dietetic factor.

This work was done in our Surgical Research Laboratory by Dr. R. C. Pande, M.B.B.S.

The estimation was carried out on 86 cases. The minimum figure was 73 mgm. in a child aged 10 years and the maximum was 250 mgm. in an old man of 60 suffering from enlarged prostate with secondary vesical calculus, the average coming to 145.9 mgm. The table and the graph show comparatively the number of cases which had their serum cholesterol within a certain limit.

Serum Cholesterol	No of case	Percentage
Below 100 mgm.	4	4.7%
Between 100-119 mgm.	15	17.4%
" 120-139 "	25	29.1%
" 160-179 "	11	12.8%
" 180-199 "	10	11.6%
" 200-220 "	5	5.8%
Above 200	2	2.3%

In our series of cases the reading is higher than that found in the whole blood in India by other workers but is approaching the values obtained in other countries.

The ingestion of food rich in Cholesterol for some time has been known to produce an increase in the blood cholesterol. Gardner and Lander in 1913 (quoted by C. Lyons 1931) carried out experimental work on cats and were able to produce hypercholesterolemia after giving a large amount of cholesterol to eat on a single occasion. In dogs the systemic blood fat begins to rise 1 to 2 hours after a meal and reaches its maximum after 6 hours (S. Wright). In human beings it has been the aim in the present work to study the changes in the amount of cholesterol in the blood after a single ingestion of fatty diet and to compare it with the results so obtained in cases of cholecystitis. At the very outset it may appear that the test of giving fatty diet may not be safe in cases of cholecystitis but fortunately in this series of cases no complication or trouble occurred. The diet which has been prescribed does not contain such an excess of fat which can upset the patients but has enough of cholesterol in it to make the estimation desirable. The test need not be done in cases of acute cholecystitis in which the diagnosis is obvious. It is certainly very helpful in the obscure and chronic cases. In acute cases if one is particular the test should be applied after the acute symptoms have subsided and the patient is allowed solid diet.

#### METHOD.

The patient whose cholesterol metabolism is to be studied is not given any food after 9 O'clock the previous night. Next morning about 2 c.c. of unoxalated blood is collected at 6 a.m. in a clear dry test tube. Every care is taken to prevent

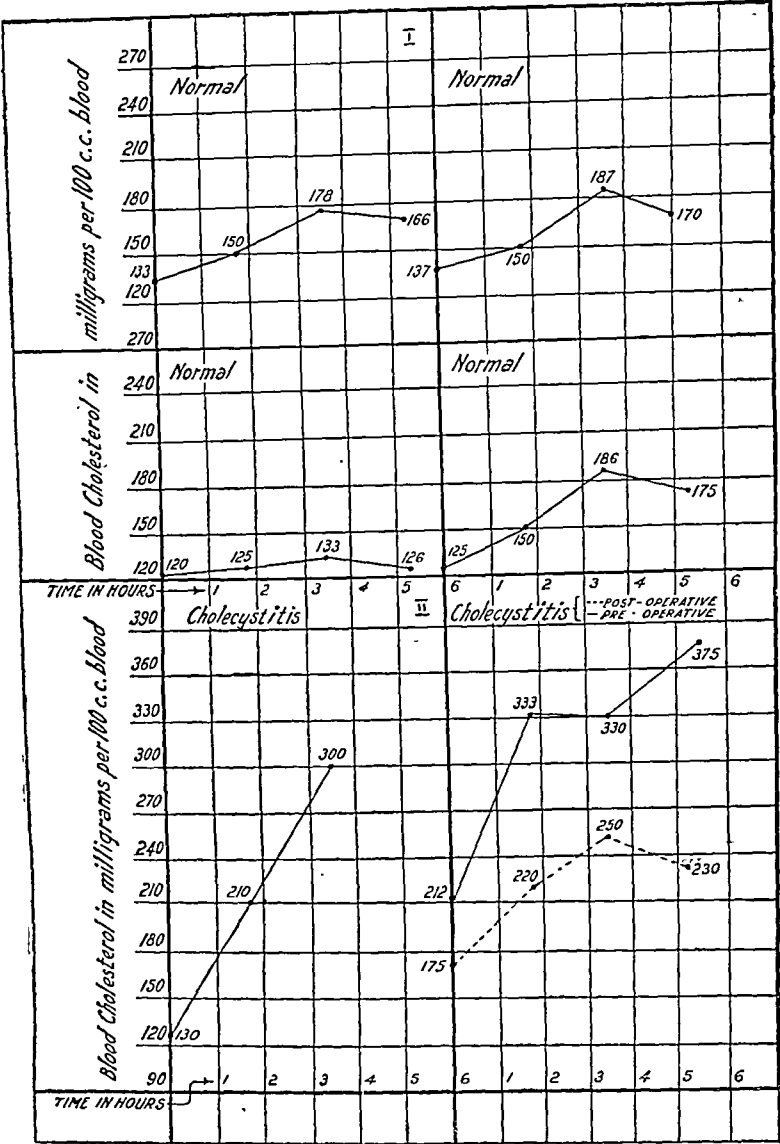


Fig. 1

haemolysis of blood (by use of dry sterile all glass syringes).

At about 8 a.m. or even earlier if it can be managed the patient is given 12 ounces of milk and 2 ounces of butter to eat on empty stomach. Three samples of blood are collected after every  $1\frac{1}{4}$  hours. During this period patients should not be given anything to eat, but if they feel too thirsty they can be given a small amount of water to sip during summer months. The collected blood is allowed to stand in

an incubator at  $37^{\circ}\text{C}$  for half an hour in order to separate the serum. The serum is taken in a small tube and centrifugalised. 0.2 c.c. of the clear serum is mixed with a mixture containing 9 c.c. of absolute alcohol and 3 c.c. of ether. It is shaken well and left for 20 minutes and later on centrifugalised (2,000 to 3,000 rounds per minute) again till the fluid becomes clear. The clear fluid is poured in a beaker and is allowed to evaporate slowly. Cholesterol is left behind. The dried cholesterol

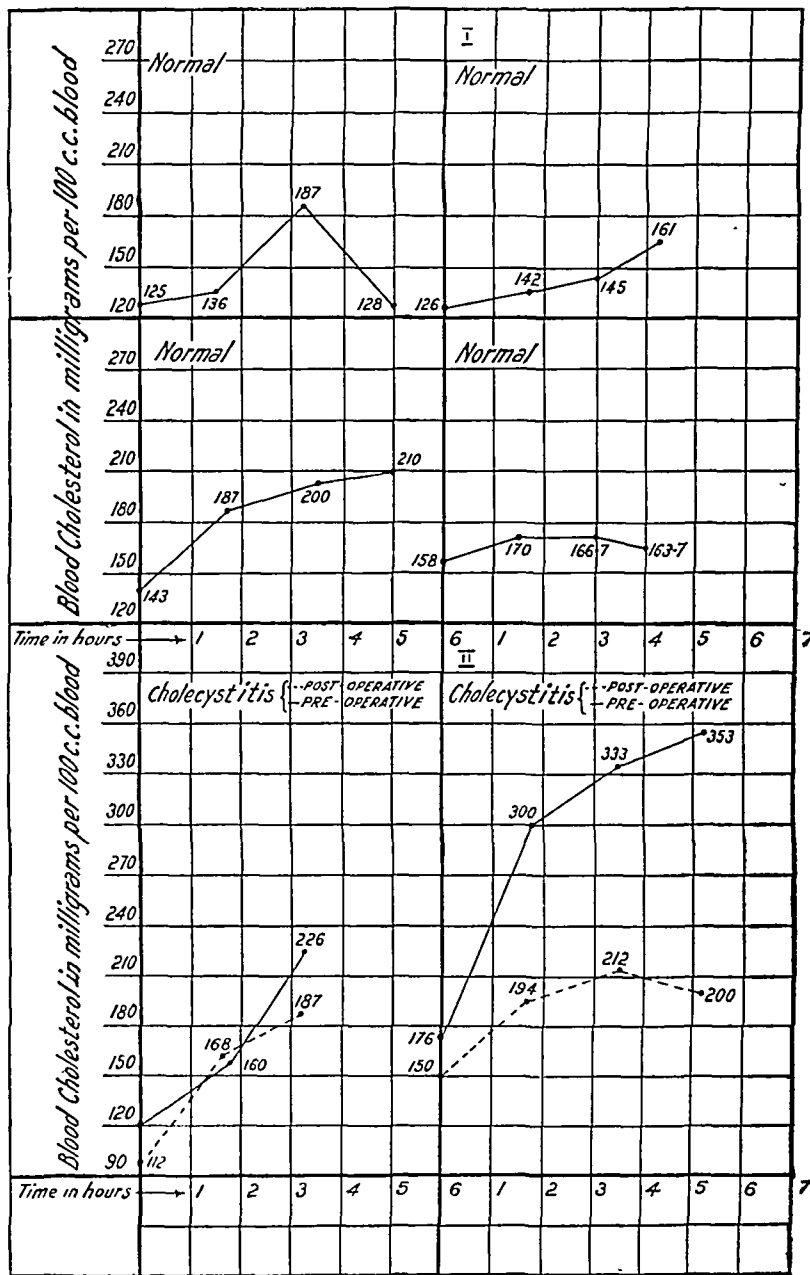


Fig. 2

is dissolved in 5 c.c. of chloroform. The colour is matched in a colorimeter by Leiberman and Burchard method by adding 2 c.c. of acetic anhydride and 0.2 c.c. of sulphuric acid, and comparing this colour with a standard containing 0.08 mgm. of cholesterol in chloroform per c.c. 12 patients of different diseases have been selected at random from the wards. Each estimation takes roughly 6 to 8 hours. Colorimetric methods cannot claim the degree of accuracy obtained by gravimetric methods by Digitonin precipitation

but a series of observations done by the same observers in one time keep their comparative value unimpaired.

It was found that 11 out of 12 cases showed the maximum rise in cholesterol level below 80 mgm; only in one case the figure was high. The average comes to be about 52 mgm. Taking these figures as our average we proceeded to work on cases of cholecystitis. Seven cases of gall bladder disease could be studied out of which 6 were cases of chronic cholecystitis and one was a case of cancer gall bladder

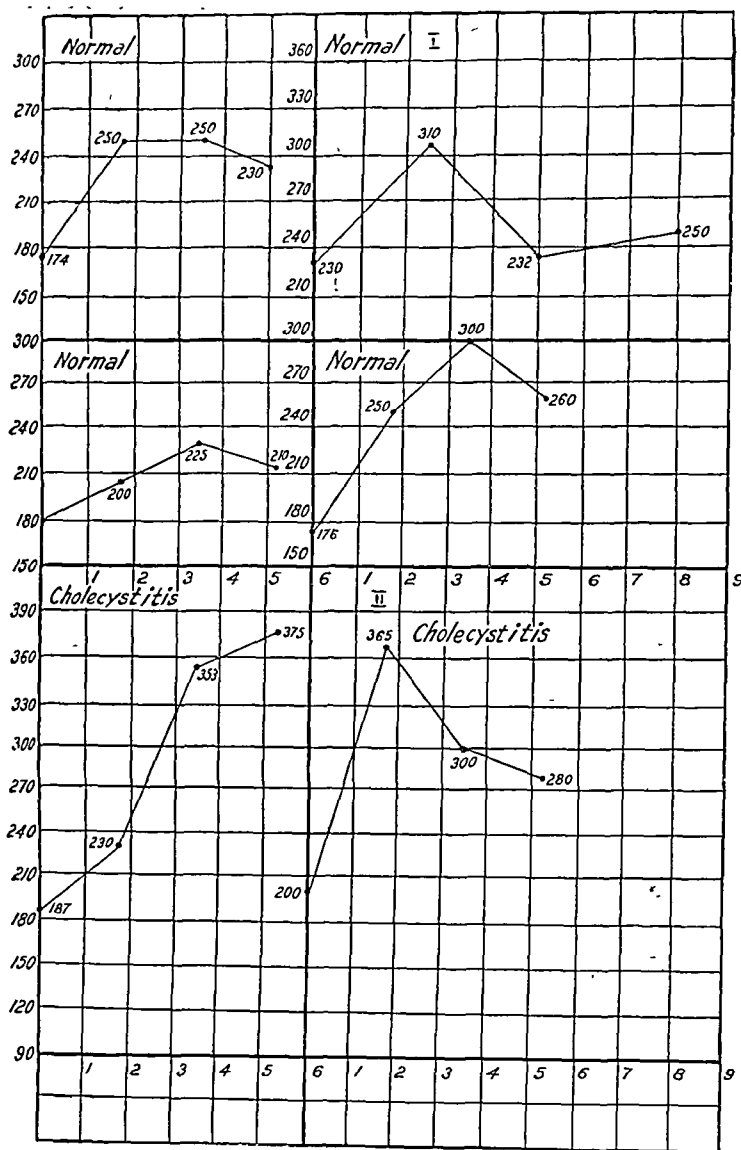


Fig. 3

as proved on the operation table. In three cases the cholesterol metabolism could be studied both before and after operation and it was noticed that the rise in the level was not so high after the operation of removal of the diseased gall bladder.

Now if we compare tables we find that after the diseased organ is removed from the body in cases of cholecystitis the metabolism curve again becomes low like that of other normal people. It can be judged by comparing the graphs of patients who

have been operated. By the above test if the rise of cholesterol is between 100 to 150 mgm. the case is probably one of cholecystitis but if the rise is more than 150 one should be inclined to think that it almost positively is a case of cholecystitis and this adds to the existing methods of confirming diagnosis of chronic cholecystitis.

By comparing the tables one is forced to think that the marked rise in the level of the serum cholesterol in the table is cer-



tainly due to the diseased condition of the gall bladder. In all the first six cases the rise was more than 100 mgm. the minimum being 106 mgm. while the maximum was 188 mgm., the average coming to 161.5 mgm. The seventh case was of cancer gall bladder and in this case the rise was only 75 mgm. though the fasting serum cholesterol was 300 mgm. which was due to jaundice. So the conclusion forces itself

that it is only in the chronic inflammatory conditions of the gall bladder that there occurs marked rise in the level of serum cholesterol while in case of new growth this was not noticed.

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### RADIATION TREATMENT OF CARCINOMA CERVIX UTERI

(With follow up report on 72 cases treated during the period 1935—1943)

by DR. P. RAMA RAU, D.M.R. (Vienna), *The Madras Radiological Institute, Kilpauk, Madras.*

The first phase of treatment of Carcinoma of the cervix was surgical. The second or radium phase developed as a natural sequence of unsatisfactory surgical experience. The third phase consisting in the addition of adequate external Roentgen irradiation to the use of radium, followed the realisation that control of lymphatic involvement of the parametrium is the most important factor in the management of these cases. This was naturally an outcome of further observations of cases treated and the recurrences that occurred in the lymphatic glands. In cases of accidental deaths after radium application for Grade I carcinoma of the cervix autopsy revealed metastatic involvement of even the sacral group of glands, so that it is felt necessary to treat even Grade I cases with adequate external X-rays, as well as local radium applications. Success depends on the maximal doses being given at the first instance alone. In our own experience, most of the cases that came into the clinic in the early years, were advanced recurrences in glands after radium treatment with none at all, or not adequate enough of deep X-ray treatment externally. I briefly give the classification of cases and results.

No. of cases.	Alive for in years.										Alive total.
	2	3	4	5	6	7	8	9	10		
Grades I & II 34	9	4	4	5	-	5	1	3	1		32

Of the 34 cases belonging to Groups I & II, two were lost sight of within one year (1936 cases). All the others are alive and were checked up to June 1945. This group includes one case who had in 1941 post operative radiation following vaginal hysterectomy. There was accidental damage to the bladder wall and a VVF. This was repaired six months after radiation and the patient is well to-day. A second case had radium outside in 1941 and no deep X-rays. She came in 1943 with a lump (recurrence in sacral glands) and since receiving external deep X-rays is doing well to-day. Both these were Grade I cases.

	No. of cases.	Alive for in years.										Alive total.
		2	3	4	5	6	7	8	9	10		
Grades III & IV. 38 including 16 recurrences after previous radium treatment only.		2	3	-	1	2	1	-	1	-		10

Out of 38 cases belonging to Grades III & IV, 28 died within one year; of these 16 were recurrences after previous radium, but no X-Ray therapy. Excluding these 16 cases all of whom were dead within one year, ten out of the remaining 22 are alive for varying periods. One of these Grade IV cases is interesting: Mrs. P. P. 49, admitted 16-3-'38—Large fungating growth—received 4000 r 200 K.V.-X-rays and 6000 mg-hrs. of Radium; On 5-8-'40 she returned having

had a large haemorrhage. Local condition: Dome of vagina closed and cervix atrophied; parametria free. Tissue from uterus showed no evidence of malignancy. 50 mgms of radium were inserted and kept in for 24 hours. She was all right on 1st February 1943, reported herself for sciatica. Radiography revealed spondylitic changes; there was no local recurrence; laparotomy revealed secondaries in front of the 1st piece of sacrum. It was considered best to leave her alone. She died in September 1944. Lived for about 6½ years.

It is, therefore, essential that the pelvic lymphatic system including hypogastric, obturator, ureteral and sacral glands should all be adequately irradiated about the same time as radium is applied. A technique of combined radium and external deep X-ray developed by us has been very satisfactory as the above results show, especially, after the installation of high voltage apparatus of 400,000 volts in 1938. The whole combined course of treatment takes four to five weeks. There was no need to break treatment except in cases where occasionally complications arose. A supporting therapy with liver extract, iron and Vitamin B (last, in fairly large doses of 25 mgms. parenterally daily) has minimised blood changes and Roentgen sickness. Weekly blood counts have shown no change except some drop in the WBC which returns to normal within 3 or 4 weeks after cessation of radiation therapy. With the higher voltage, there has been no complications like diarrhoea and extreme sickness nor the skin burn found with the application of lower voltages like 200,000 or 180,000.

#### METHODS OF RADIATION :

There are several methods of radiation therapy, the more commonly adopted being, what is known as the "Stockholm" or "Paris" methods and their modifications. It chiefly consists in putting radium into the fornices with the colpostat in addition to the cervix proper to enable adequate irradiation of parametria. Additional external radiation is also given. External therapy consists in irradiating through 4 or 6 fields around the pelvic girdle, each of which receives 2000 r (2 fields daily, each field receiving 200 r),

with tension of 200,000 volts and 1 or 2 mm. Cu.filter. Internally 6,000 to 8,000 mghrs. of radium is applied half intracervically, and half in the vagina. This is done in two sessions, three weeks apart. Some apply radium after deep X-ray therapy, others follow radium with deep X-rays. The tendency now is to prefer giving deep X-rays first and when the tumour has shrunk, follow up with radium. I shall not go into further details of these methods in a short paper like this as there are plenty of observations published by various workers in Radiological literature.

I am using since 1938 a modified method of what is followed at the Mayo clinic and feel gratified with the results. This consists in applying the radium at weekly or six-day intervals. First dose is 1,200 mg-hrs. or less, second, 2,400 mg-hrs. or less, and a third, 2400mg-hrs or more depending on the reactions, to make a total of 6000 mg-hrs, two-thirds of the dose intracervically, and a third in the vagina against the external os. During the interval between the radium applications, external radiation with 400 k.v., 5 mm. Cu.+1 mm. Al.filter through a hypogastric field 15 x 15 cm. in daily doses of 200 r to 300 r to make a total of 3200 r to 4000 r is given. This will afford adequate irradiation of pelvic lymphatics and eliminates the necessity for application of radium to the fornices. The higher voltage also eliminates unnecessary irradiation of normal tissues which will be subjected to radiation when lower voltage of 200,000 and multiple field technique is adopted. (Radium: gamma rays 0.0175 A.U.; 400 K.V. 0.05 A.U. or about three times longer wavelength than gamma rays from Radium). There will be a cumulative radiation effect in the pelvis by this method, reaching the optimum concentration around 4 weeks or so. The general principle is to spread 5 to 8 erythema doses in the pelvis.

All cervical cancers are infected growths, and it is necessary to clear up the secondary infection before radium is applied; as else, high febrile reactions invariably follow. We usually start with external deep X-rays for the first 4 to 6 days, with daily vaginal washings with mild antiseptic douches, and then make

the first application of radium. This is found adequate and no febrile reactions occur, particularly as the first radium dose is only 1200mg-hrs. or so. In cases of cauliflower growths, Radium on a wax mould to fit the lesion is applied (dose of 1200 mg-hrs.); this is followed by the administration of the entire dose of external radiation. At the conclusion of external radiation, one invariably finds the cervix in a suitable condition to make an intracervical application of radium. By plugging the vagina with about 4 yards or so of six-inch gauze, radium is prevented from slipping out of position and the bladder and rectal walls are held away from the radium capsule. We have had no VVF or RVF in our series. Isodose curves will show how distance from source of radiation is the only method of saving rectal and bladder walls, as the radiation reduces in intensity from its source by what is known as "the inverse square law."

If at a distance of 1 cm. from the source, radiation is 100%, at 2 cm. it becomes 23.5% ; at 3 cm. it is 9.2% ; at 4 cm. it is 5.5% ; at 5 cm., 4% and at 6 cm. it is only 2.0%.

At the Radium-Hemmet, Stockholm, a routine cystoscopic examination is done; if prominent vessels are noticed it is considered as a warning of probable early involvement of bladder wall.

In Grades III & IV, only high voltage 400 K.V. external radiation is given to a maximum of 6000 r by hypogastric and sacral fields alternately. After an interval of two months a small dose of radium, 2400 mghrs. is applied intracervically if conditions permit. Else, one has to be satisfied with the results of external radiation only I have already mentioned our results.

A question often asked is the problems concerning treatment of cancer cervix associated with pregnancy. I have no personal experience in my clinic, but feel that an extract from the report from the Mayo Clinic may be given here.

"A study of 3570 cases of carcinoma of the cervix observed at the Mayo Clinic in approximately 32 years revealed that pregnancy was present in 26, or 0.7%.

"No definite conclusions can be drawn concerning the relative value of irradiation therapy; however, it appears that operation is preferable in cases in which the lesion is operable and that supplementary irradiation increases the percentage of good results. This is in contrast to the relative value of irradiation therapy and hysterectomy in cases of carcinoma of the cervix in the patients who are not pregnant.

"If the extent of the lesion permits operation and if the fetus is not yet viable, total hysterectomy is followed by irradiation; if the lesion is operable and the fetus is viable, cesarean section is followed by panhysterectomy and postoperative irradiation. In cases in which the lesion is non-operable and the fetus is viable, cesarean section is followed by irradiation; in cases in which the lesion is non-operable and the fetus is not viable, sufficient irradiation is employed to treat the lesion; incidentally, abortion occurs. When the lesion is operable, total abdominal hysterectomy has produced the best results. In 57 per cent of the cases in which this procedure was employed, the patients were free of recurrence five years after the operation."

### HORMONES AND MALIGNANT DISEASE

In the management of patients with skeletal metastasis from breast cancer X-ray castration was advocated by Ahlbom as early as 1930, the effect of such treatment being to greatly reduce the circulating estrogen. Lacassagne and others suggested treating these cases with androgen. The pronounced atrophy inducing effect of the male hormone on the ovaries is well known and Beecham (Dec. 1943) reported relief from pain and general improvement in some cases of advanced ovarian tumours and two cases of Grade IV cancer cervix by androgen therapy. I have as a routine adopted X-ray castration in all cases of cancer of breast referred to my clinic since 1937. I have not tried androgen therapy so far. Apparently it is worth trying the male sex hormone as an adjuvant therapeutic measure in malignant diseases in women, not only when the breast is involved, but also in

cancer of the cervix and tumours of the ovary. It is perhaps not wrong to assert that the comparatively unfavourable course taken by cancers in young women is due to the active condition of the ovaries and the large amount of estrone in the circulation. Reports of cases of secondaries from prostatic cancer that have improved with Stilbestrol are forthcoming in recent literature. This opens a new vista for thought—whether we could employ the neutralising effects of the female sex hormone in malignant diseases of the male and *vice versa*.

In conclusion, I must say, Radiation therapy properly planned, for early cases of cancer cervix may give us such gratifying results at present times, if only we keep an open mind as to measure and not have dogmas. The earliest case that came to the clinic sought medical advice around six to seven months after appearance of symptoms—two chief symptoms being 'blood stained discharge' after coitus and

'menorrhagia' of varying duration. The success in Grades I & II and in a few cases of advanced type (excluding those with recurrences after previous radium only) should certainly encourage us to follow on the lines adopted.

No. of cases.	Alive for in years.										Alive total.
	2	3	4	5	6	7	8	9	10		
<hr/>											
Of the total No. of 72 (deducting the 16 recurrences after previous Ra- dium only else- where) we have 56 cases in all groups. Of these 42 are alive.	11	7	4	6	2	6	1	4	1	42	

All groups together 3 year survivals: 31 out of 56, or 56%, and five year survivals, 20 out of 56 or 36%.

A complete list of the 72 cases treated is appended.

Year.	No.	Name.	Age.	Grade.	X-ray Dose.	Radium Dose.	Remarks.
1935	1	Mrs. B.	44	I	3200 r	4800 mghrs	lost sight of 42 — 6 yrs.
1936	2	Mrs. A. V.	40	I	2400 r	4800	O. K. 9 yrs.
"	3	Mrs. P. K. A.	45	I	2400 r	3600	" "
"	4	Mrs. S.	35	I	3200 r	4800	" "
1937	5	Mrs. A.	43	I	2400 r	4800	" 8 yrs.
1938	6	Mrs. T.	52	I	3200 r	3200	" 7 yrs.
1940	7	Mrs. S.	48	I	3200 r	6500	" 5 yrs.
1941	8	Mrs. S.	30	I	4800 r	2800	" 4 yrs.
1942	9	Mrs. B. P.	35	I	3200 r	6000	" "
"	10	Mrs. A.	41	I	4800 r	5200	" "
"	11	Mrs. F.	28	I	3200 r	2100	" "
1943	12	Mrs. A.	41	I	3200 r	4992	" "
"	13	Mrs. M.	41	I	3200 r	4560	" "
"	14	Mrs. D.	35	I	3200 r	4900	" "
"	15	A	45	I	3200 r	4800	" "
"	16	Mrs. S.	70	I	3200 r	5760	" "
"	17	S	68	I	3200 r	4800	" "
1941	18	Mrs. J.	45	I	4800 r	After hysterectomy — accidental VVF Repaired in 6 months after deep X-rays. O.K. now.	
1943	19	M	45	I	3600 r	Ra. elsewhere in 1941—no deep Xrays. Recurrence in sacral glands—O. K. now.	

Year.	No.	Name.	Age.	Grade.	X-ray Dose.	Radium Dose.	Remarks.
1935	1	K	30	II	2400 r	2400 mghrs	O. K. 10 yrs.
"	2	M	40	II	2400 r	1800 "	lost sight of within 1 year
"	3	A	55	II	2400 r	9590 "	"
1938	4	R	31	II	6000 r	6300 "	O. K. 45 — 7 yrs.
"	5	L	65	II	6400 r	7100 "	"
"	6	D	41	II	3200 r	6300 "	"
1940	7	B	50	II	7200 r	1000 "	O.K. 45. Note small dose of Ra. short vagina menopause 8 years ago infantile uterus, long rigid cervix felt per rectum.
"	8	N	50	II	3200 r	6200 "	O. K. — 5 yrs.
"	9	C	38	II	5600 r	5520 "	"
"	10	K	40	II	7800 r	1200 "	O. K. — 5 yrs.
1941	11	K	46	II	4000 r	5500 "	4 yrs.
1942	12	M	36	II	3600 r	6000 "	3 yrs.
1943	13	S	31	II	4000 r	6175 "	2 yrs.
"	14	P. V.	41	II	3200 r	6210 "	"
"	15	B	31	II	3200 r	5950 "	"
1935	1	B	60	III	5600 r	2800 "	Dead — 19-1-'36.
1936	2	R	30	III	9800 r	6300 "	O. K. — 9 yrs.
"	3	K	36	III	—	4800 "	Dead—Nov. '38, 2 yrs.
1939	4	S	30	III	1200 r	3456 "	Lost sight of.
"	5	B	58	III	2400 r	3800 "	O. K. 45 — 6 yrs.
"	6	L	48	III	3600 r	5750 "	"
"	7	A	54	III	3200 r	Ra. elsewhere	—recurrence—lost sight of.
1940	8	M	41	III	3200 r	6360 mghrs	O. K. 45—had a mass to be felt per rectum which burst into the rectum 4 months after treatment.
1941	9	B	42	III	4000 r	Ra. elsewhere	—Recurrence—lost sight of.
1942	10	D	48	III	5600 r	3000 "	O. K. 45 — 3 yrs.
1943	11	S	36	III	9400 r	3800 "	Dead 2-7-'43.
"	12	B	38	III	5600 r	1800 "	Died within one year.
"	13	GKS	34	III	4800 r	5800 "	Died in June '45 of acute abdomen—no recurrence —2 yrs.
"	14	D	35	III	4800 r	1260 "	Died — Jan. '44.
"	15	K	40	III	4000 r	5500 "	O. K. 45.
"	16	R	34	III	4000 r	5650 "	Died of peritonitis.
1935	1	M	58	IV	3200 r	1410 "	Lost sight of.
"	2	A	—	IV	3200 r	1800 "	Dead 17-2-'36.
"	3	B	60	IV	5600 r	2800 "	Dead 19-1-'36.
1936	4	R	40	IV	2400 r	Ra. elsewhere	—Recurrence—lost sight of.
"	5	E	41	IV	3750 r	Ra. elsewhere	—Recurrence—died 23-6-36
"	6	P	48	IV	4800 r	3750 Mghrs	Lost sight of — July '39.
1937	7	I. C.	43	IV	2400 r	Recurrence after Ra. outside VVF	—died within one year.
1938	8	S	54	IV	5600 r	3560 mghrs	Lost sight of.
"	9	P	49	IV	4000 r	7200 "	Died 44 — 6½ years.
1939	10	T	57	IV	6400 r	1550 "	Died within one year.
"	11	M	24	IV	4000 r	600 "	Lost sight of.
"	12	P	40	IV	2400 r	1380 "	"
"					2400 r	2375 "	"
"	13	S	35	IV	2400 r	4250 "	Died June 1940.
1940	14	D	59	IV	2000 r	Ra. elsewhere	—Recurrence.
"	15	B	38	IV	6800 r	"	Died 1941
1941	16	R	35	IV	5600 r	"	"
"	17	M	47	IV	4800 r	"	Died within one year.
"	18	A	54	IV	3200 r	Ra. elsewhere	—recurrence—dead.
1942	19	B	65	IV	4000 r	"	"
"	20	P	43	IV	8200 r	"	in 40—died within 1 year.
"	21	P	50	IV	4800 r	Ra. elsewhere	—Recurrence—dead.
1943	22	A	49	IV	6000 r	"	"

## IRREDUCIBLE COMPLETE PROLAPSE OF THE RECTUM

by DR. S. P. SRIVASTAVA, M.S., F.R.C.S. (Eng.), Medical College, Agra.

Complete prolapse of the rectum has been met with in U. P. among children, the middle-aged and old males and females alike. Females are said to be more often affected than males and a greater incidence of complete prolapse is observed in women who have suffered the strain of parturition than in those who have never borne children.

The cause of complete prolapse in children is in most cases stone in the bladder and constant straining at micturition invariably results in this condition. In two cases I have come across rectal polypus as the cause and in a few, chronic colitis and malnutrition.

The adult cases have been mostly subjects of chronic dysentery resulting in gross secondary anaemia and complete prolapse due to straining.

Apart from pregnancy there are two other causes which have been described: Many subjects are extremely stout and the increasing intra-abdominal fat would appear to be the causative factor. Some subjects are of the thin type and usually present well-marked signs of visceroptosis with perhaps inguinal hernia and general yielding of the abdominal wall.

None of my cases was excessively stout, and if so they were cases of partial prolapse in association with internal piles.

The view of Moschowitz that complete prolapse of the rectum is really a type of hernia is now commonly accepted. Yielding of the pelvic fascia takes place as a result of straining or increasing intra-abdominal pressure and owing to the firm attachment of the peritoneum to the anterior wall of the rectum, a sliding hernia takes place first of the anterior and then of the posterior rectal walls until finally the prolapse appears through the anus. Tuttle states that if the length of the prolapsed rectum is more than two inches it can be taken as certain that a hernial sac is present.

Complete prolapse is usually reducible; it descends with increasing frequency, coughing and sneezing bringing the prolapse down and finally it may appear even on standing or walking so that an invalid life has to be adopted. Bleeding occurs in large quantities through abraded mucous membrane. Irreducibility is a common complication, the cause of which is probably sphincteric spasm at first and later, oedema of the layers of the rectal wall. Omentum or small intestines have not been met with in the peritoneal pouch nor have there been symptoms of intestinal obstruction or strangulation.

The two cases of unreduced prolapse gave histories of the protrusion coming on suddenly during straining, all efforts at reduction failing. Reduction was tried under anaesthesia with no result. In both the cases there was no obstruction to the passage of faeces and flatus, but in one case there was retention of urine in the beginning.

In both the cases there was superficial ulceration of the mucous membrane and foul discharge, which cleared up by the use of antiseptic dressings. After waiting for about one to two weeks, the operation of Recto-sigmoidectomy had to be resorted to, conservative treatment having failed. In one case in our hospital prolonged short wave therapy was successful in reducing the prolapse. In my opinion, unless the case is attended to immediately it is difficult to reduce it because adhesions form between the layers of the rectal wall binding them together and the supervention of oedema makes reduction difficult.

Amputation of a prolapsed rectum was originally carried out as an emergency measure for irreducibility and threatened gangrene. Auffret performed the operation in 1882 on a case of this type. Mickulicz described in 1888 a series of 6 cases of amputation of the prolapsed rectum; the indication in his first case was an acute irreducible prolapse and the successful issue led him to extend the use of the

operation for cure of severe habitual prolapse of the rectum. Throughout his operation of circular resection the wound was irrigated with a dilute solution of carbolic acid, the peritoneum was opened and then closed by suture; the prolapse was amputated and the two intestinal walls were joined by deep sutures of silk which caught up all the layers of the bowel wall. At the end of the operation the suture lines were painted with Iodoform, the sutures were cut short and the bowel replaced. In the six cases reported by Mickulicz immediate healing of the wound and lasting recovery resulted.

Further cases of prolapse treated by amputation were described by Treves, Cunningham and by Sheldon, the latter in particular suggested several important details in technique. The credit for re-establishing the operation on a sound basis is due to Miles who coined the new term "Recto-sigmoidectomy".

The operation is preferably carried out under general anaesthesia but I have found spinal anaesthesia quite good though it is said that in the latter there may be accompanying contraction of the bowel wall, due presumably to the remaining vagal influence, making it difficult to deliver the prolapse fully.

The patient is kept in the lithotomy position and a circular incision is made 1" distal to the anal margin through mucous and muscular coats. The bleeding points should all be caught and tied. The peritoneum is opened for about 3" in front of the lax pelvic colon which is drawn taut after which it is sutured to the front of the pelvic colon. The latter is cut leaving an oval lumen which is sutured to the remaining portion of the rectal wall. Four mattress sutures are introduced at the four corners first and then the two walls of the bowel are sutured by a continuous layer of catgut. The suture line will be observed to recede to its proper position inside the rectum. A finger is passed to feel that the suture line is smooth and at this stage the funnel effect of the Dilated anus narrowing to the contracted pelvic colon is very remarkable. A firm pad of wool is applied and the patient is returned to bed, the foot of which is raised on blocks for 6 to 12 hours. The bowels are

made to act on the fifth day or so by giving an aperient, but no enema is given.

\* \* \*

CASES: (1) Name—B. aged 40 years, was admitted with retention of urine and irreducible prolapse of the rectum. An attempt to reduce the prolapse failed; hot or cold applications and short-wave therapy were of no avail. He was operated on under spinal anaesthesia and made an uneventful recovery. He had incontinence of urine for about a week after which the sphincters regained their tone. The bleeding on incising the walls of the rectum was very little. He was given sulphonamides, pre and post-operatively and intravenous saline and glucose. He had about half a pint of serum transfusion also.

In this case prolapse occurred for the first time and was irreducible.

(2) Name: T. Rām, aged 35, Hindū male; complained of unreduced prolapse rectum which occurred due to straining at stools. The prolapse used to be reducible but this time it was not. The prolapsed portion was oedematous and patches of necrosed tissue was present on its surface. Fomentations and short-wave were of no avail. He was operated on after about a fortnight and rectosigmoidectomy was done. The patient made an uneventful recovery and was discharged after about 3 weeks.

(3) One case of unreduced prolapse got itself gradually reduced by short-wave diathermy exposures after several days and no operative treatment was necessary. Such a course is possible only when perhaps there are no adhesions and as the oedema subsides the prolapse disappears. One feature with all these cases of unreduced prolapse is that they do not have any obstruction to faeces or flatus and the only care to be taken is to avoid sepsis by frequent antiseptic dressings.

(4) One case, aged about 40 years of reducible prolapse was operated on and rectosigmoidectomy was done; but owing to existing anaemia and general debility he could not sustain the shock of the operation and so succumbed as a result of it. Blood transfusion, which might have been beneficial was not available. He was a chronic case of colitis and his general constitution was of the thin type. The Lockhart-Mummery operation was a failure in this case as has been found in other cases too.

**Conclusion**—Rectosigmoidectomy is the treatment of choice in cases of unreduced prolapse when reduction is not possible even under general anaesthesia. The operation can safely be done under spinal anaesthesia after waiting for a few days for the superficial sloughs to be cleared away. Pre-operative treatment of anaemia with liver extract and blood transfusion is essential before operating by the Mickulicz technique for irreducible prolapse in Indians.

## A CASE OF CHONDROMA OF THE SCAPULA

by LT.-COL. C. R. KRISHNASWAMI.

T...Z, a Bengali Muslim aged 55 years, employed in a hospital ship as a coal trimmer, struck his shoulder about the 20th of October '44, against the side of the ship while it rocked in stormy weather. The M. O. who saw him at the time re-

He was evacuated and admitted to this General Hospital on 30-11-'44. The following were the findings here:—"A bony-hard irregular swelling was felt in the right infra clavicular region, in the position of the coracoid process and had probably been growing for some years. There was no tenderness or oedema over it. The patient had no referred pain. No prominence or swelling was noted on the dorsum of the scapula, while the tumour was palpable in the axilla and was of the same uniform bony hard consistency and knobby. Abduction and external rotation of the arm were considerably limited, but other movements were full.

### X-RAY FINDINGS:

"A bi-lobed growth about the size of a tennis ball involving the neck of the scapula and the coracoid process. No evidence of fracture".

Clinical examination was otherwise negative. The urine was normal and the Kahn was negative.

Operation was performed on 6-1-'45 under gas and Oxygen general anaesthesia.



Fig. 1.  
T-Z—

[Note the Swelling in the Infra Clavicular Fossa].

ports—"No fracture. The force, though trivial in itself, was important in bringing to notice a serious underlying pathological lesion."

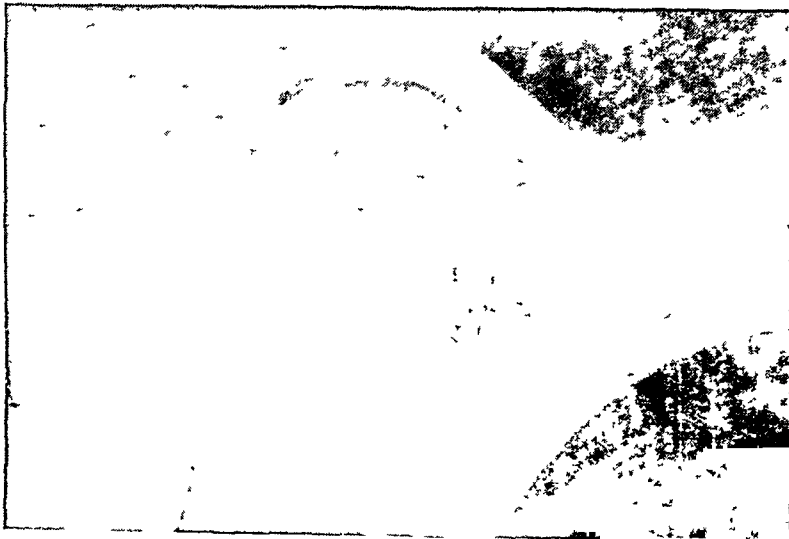


Fig. 2  
Skiagram Showing the Tumour.



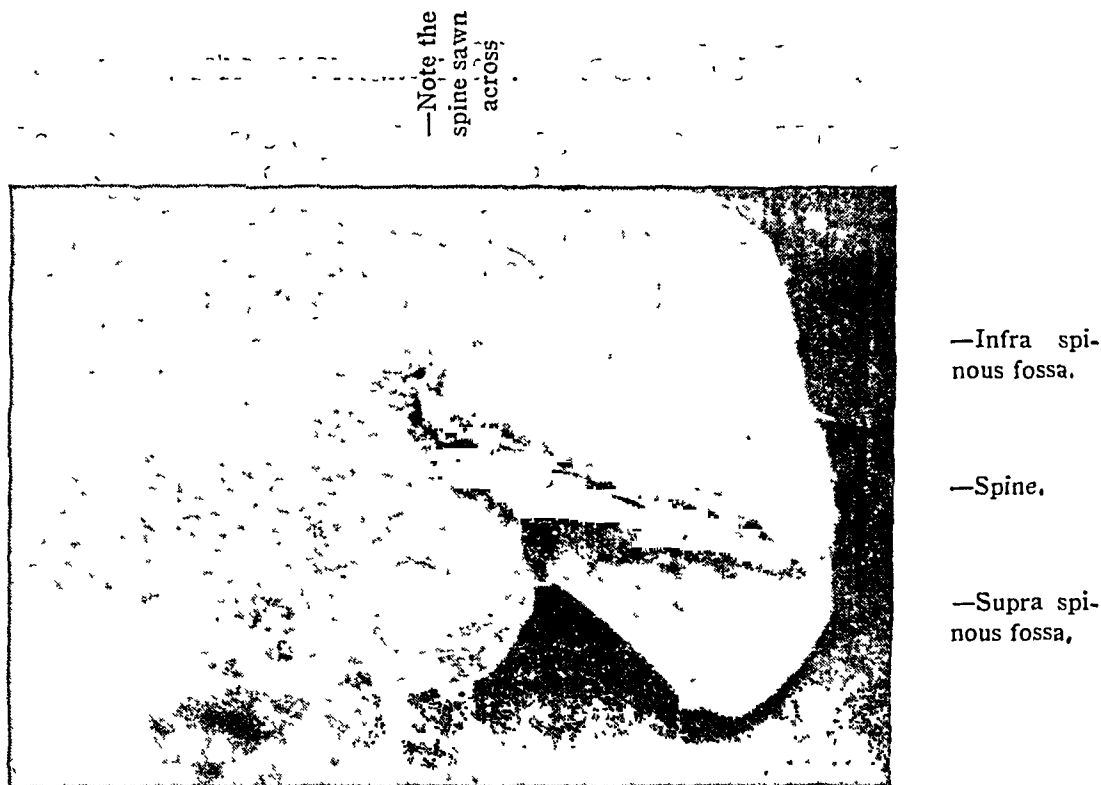


Fig. 3.

One View of the Excised Scapula.

The patient was put flat on the table, and a sand bag was placed under the scapula to open out the infra-clavicular region.

A vertical incision was made from a point lateral to the normal position of the coracoid process and extended down the delto-pectoral groove for  $2\frac{1}{2}$ ". The cephalic vein was avoided and the Deltoid muscle retracted. A prominent portion of the tumour could be seen with stretching of the structures in front of it. After the pectoralis minor muscle was divided, the depth of the axilla could be inspected, and the axillary artery was seen and the Sub-Scapular branch was identified and ligatured.

The short head of the Biceps and the Coraco-Brachialis were detached from the tumorous Coracoid process and the Sub-scapularis divided in front of the tumour and dissected from the growth as much as possible. As much of the anterior half of the capsule of the shoulder-joint as could be seen easily at this stage was divided.

A mop was then placed in the wound, and the skin flaps were brought together temporarily by tissue forceps.

The patient was now turned to the left so as to bring the right scapular region into view.

A "T" shaped incision was made over the scapula, the vertical limb along the vertebral border and the horizontal along the spine of the scapula. The flaps of skin and subcutaneous tissue were raised. The trapezius and Deltoid were detached from the spine up to the acromion process. The Levator anguli scapulae, both the Rhomboids and a few fibres of the Latissimus Dorsi at the lower angle of the scapula were next divided. Next the Supra-spinatus and Omohyoid muscles were divided at the upper border of the scapula and the supra scapular artery was ligatured. The Infra-spinatus was divided about its middle and the Serratus magnus was detached from the vertebral border. The scapular spine was sawn through at the beginning of the acromion process.



Fig. 4.

View Showing Unaffected Glenoid Cavity.



Fig. 5.

Another View of the Excised Scapula.

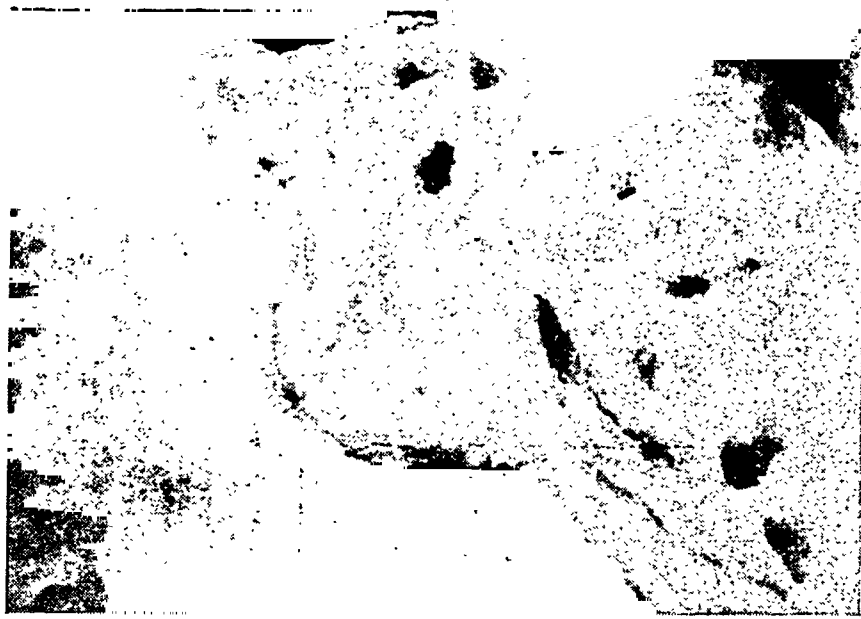


Fig. 6.

Tumour sawn through showing areas of degeneration

The scapula was now freely mobile and lifted out after division of the Teres muscles, the long head of Biceps, Triceps, and the remaining portion of the capsule of the shoulder joint on the posterior aspect.

A careful inspection of the head and neck of the Humerus showed these structures to be normal.

The detached portions of the Trapezius and the Deltoid were brought together by a few stitches as well as also the Serratus and the Rhomboids.

The skin was sutured anteriorly and posteriorly and to complete the operation a drain was left in the posterior wound.

The operation was practically bloodless due to the primary ligature of the subscapular artery and the patient's general condition was excellent at the end of the operation.

The acromian process was left behind as it was not involved, and to give the deltoid and the Trapezius, a good purchase to act and to preserve the contour of the shoulder.

The post operative convalescence of the patient was absolutely uneventful and afebrile and the wounds healed by first intention.

Limb was put up in a Thoraco-Brachial plaster with the arm in abduction at 90°.

Report by Major MORGAN, R.A.M.C., Pathologist:—

*Microscopic*—The specimen is a scapula showing a large knobby tumour of cartilagenous consistency originating in the bone and forming large protuberances, above and below the spine of the scapula. On sawing this across, it has the appearance of a simple Chondroma.

*Histology*—Portions from the superficial and deeper parts of the growth show a Chondroma, with no evidence of malignant change."

At the time of discharge, I am told that he was able to abduct his arm to a right angle, more not being possible, internal rotation was possible to the full extent, external rotation being limited by about 15°.

It was unfortunate that during the absence of the writer on leave the patient was discharged from the hospital without a clinical photo to demonstrate the range of movements possible after operation, and a skiagram to show the disposition of the parts, and the position of resting of the head of the Humerus on the chest wall.

My thanks are due both to General P. H. Mitchner and Colonel G. R. Oberai who were kind enough to give me permission to publish this case.

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### The Annual Conference

The Seventh Annual Conference of the Association of Surgeons of India will be held in Mysore on 27th, 28th and 29 December, 1945. Dr. B. N. Balakrishna Rao, M.B.B.S., F.R.C.S., K. R. Hospital, Mysore, is the Local Secretary and all members intending to attend are requested to get into touch with him as early as possible.

### Registry of Sarcoma of Bone

It was decided at the last Conference that a Registry of Sarcoma of Bone is to be maintained under the auspices of the Association. Dr. V. R. Khanolkar of the Tata Memorial Hospital, Bombay, has very kindly consented to make the necessary Pathological study of Specimens. All Surgeons are, therefore, requested to send short but complete notes of cases of Sarcoma of Bones under their care to Dr. Khanolkar along with X-Ray and Clinical photographs, if any, and a piece of embedded tissue or two unstained slides. It is particularly requested that all Surgeons will co-operate in this endeavour.

### The Library

The attention of all members is invited to the Circular regarding the Library. A separate account has been opened and donations and subscriptions may be sent to the Secretary. Suggestions regarding books and journals to be acquired are welcome. Donations will be acknowledged in the Journal from time to time.

### List of Donors

(Since publication of the previous list)

Capt. V. L. Suryavanshi	Rs.	50	0	0
Previous total	„	3,457	0	0
Grand total	Rs.	3,507	0	0

### Subjects for Discussion

#### 7th Meeting:

##### 1. Traumatic Surgery of the Skull—

Opener: Dr. R. N. Cooper, Bombay.

Second: Dr. G. D. Kapur, Lahore.

##### 2. Enlarged Prostate—

Opener: Dr. S. R. Moolgavkar, Bombay.

Second: Dr. S. S. Anand, Lahore.

##### 3. Fractures of the Neck of the Femur—

Opener: Dr. B. N. Sinha, Lucknow.

Second: Dr. A. K. Talwalkar, Bombay.

#### 8th Meeting:

##### 1. Carcinoma of the Rectum—

Opener: Dr. C. P. V. Menon, Madras.

Second: Dr. E. J. Borges, Tata Memorial Hospital, Bombay.

##### 2. Carcinoma of the Cheek—

Opener: Dr. B. M. Joly, Delhi.

Second: Dr. K. M. Rai, Madras.

##### 3. Hare Lip and Cleft Palate—

Opener: Dr. S. C. Sinha, Calcutta.

Second: Dr. M. G. Kini, Madras.

#### 9th Meeting:

##### 1. Bone Tumours—

Opener: Dr. D. R. Meher Homji,  
Bombay.

Second: Dr. M. G. Kini, Madras.

##### 2. Intracranial Tumour—

Opener: Dr. A. V. Baliga, Bombay.

Second: Dr. R. N. Cooper, Bombay.

3. *Burns*—

Opener : Dr. M. R. Munawar Ali,  
Hyderabad.  
Seconder :- Dr. G. M. Phadke, Bombay.

**Prize Essay**

The offer of a prize of Rs. 150 for the best Essay on "Infections of the Foot" is renewed. The following are the conditions:—

1. The competition is open to all qualified medical practitioners registered in India, who have been in practice for not more than 10 years after qualification.

2. The essay should be based on original work and should be written in English.

3. It should be type-written on one side of the paper only and should not contain the name or other indication of the identity of the competitor. Four copies should be submitted.

4. The name, address and qualifications, however, should be written on a separate sheet of paper and enclosed with the essay.

5. The subject is "**Infections of the Foot**" and the essay should reach the Secretary before the 1st October 1945.

6. The copyright for the winning essay will remain with the Association of Surgeons of India and will be published in the Indian Journal of Surgery. Other essays will be returned to the senders, if accompanied by stamped addressed envelopes.

7. The Governing Body may, at its discretion, withhold the prize if the essays submitted do not come up to the standard.

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C. P. V. MENON,  
Hony. Secretary.

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## ON THE ANATOMY OF THE INGUINO-HYPOGASTRIC AND INGUINO-FEMORAL REGIONS\*

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### INTRODUCTION

For some years now, the writer and his assistants in this department have been observing in the local material, that the muscles—the internal oblique and the transversus—of the anterior abdominal wall, actually arise from the entire length of the inguinal ligament and not from its lateral part only as is described in the textbooks. The implication of this fact is far-reaching in that we have to discard the conventional description of the inguinal canal. We have often been unable to demonstrate to the students the ‘arching of the lower margins’ of these muscles to form the roof of the canal,—unless it be by removing their continuity with the ligament—and the several structures like the conjoint tendon, Hesselbach’s ligament, Thompson’s ligament, Henle’s ligament and so on.

It is seen from the survey of the available literature, that the anatomy of these regions has attracted the attention of the anatomists and the surgeons from very early times as it is frequently the site for varieties of hernia. The description of those regions given by the previous writers are many and varied. In recent times some authors have questioned the correctness of the conventional text-book descriptions.

\*This is an elaborated thesis of some of the views expressed at the Annual Conference of the Mysore Medical Association held at Bangalore in January, 1945.

### MATERIAL AND METHOD

Observations were made on fifty (50) cadavers of both sexes. The inguinal, hypogastric and femoral regions were carefully dissected by the writer and his assistants or by the students under instruction. Special dissections were done from the peritoneal aspect. The muscles and the fascia were examined by transillumination. A few full-term fetuses were also dissected. Lastly, transverse and sagittal sections of the regions in question were studied under the dissection microscope.

Many of our findings just corroborate the descriptions given recently by writers like Anson (1938) and Chandler (1944). Other findings are at variance with the text-book descriptions and with the observations of the writers on this subject mentioned above. A general description, based on the above study and considered to be the normal picture, is given below. Under each heading the variations from the type are also mentioned. The differences have no sex relationship. It is found further that the anatomy often differs on the two sides in the same subject.

### DESCRIPTION

There are three fascial layers superficial to the muscles in the anterior abdominal wall below the umbilicus. They are the two layers of the superficial fascia—the Camper’s and the Scarpa’s fasciae of the text-books—and a third fascial investment, which the American anatomists call the

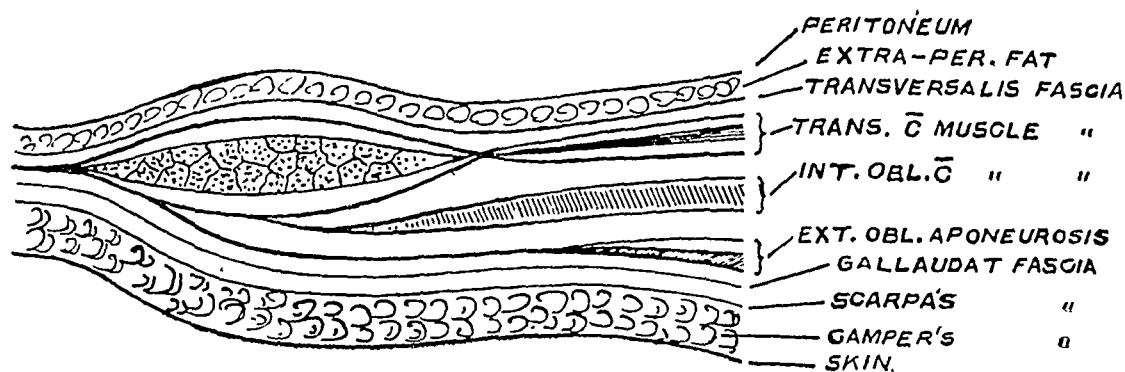


Fig. 1.

Tr. Section of Ant. ABD. Wall below Umbilicus.

fascia innominata of Gallaudat. This deep layer passes across the inguinal ligament into the thigh and blends with the fascia lata; medially it passes on to the penis to blend with Buck's fascia. Each of the muscles of the wall has, as well, an intrinsic connective tissue investment known as the muscle fascia. (Fig. 1).

### M. OBLIQUUS EXTERNUS

In the infra-umbilical region, this muscle is replaced entirely by its aponeurosis. This aponeurosis is invested on both sides by the muscle fascia. Two sets of tendinous fibres interlace to form this broad aponeurotic sheet. This passes in front of the M. rectus abdominis and its sheath to get inserted to the linea alba. It does not blend with the deeper layers and hence it cannot be said to contribute to the formation of the rectus sheath. (Fig. 1). Lower down, near the pubic crest, the transverse fibres are few and scattered so that the oblique set easily splits to form the crura of the external ring for the passage of the spermatic cord. The transverse fibres and the muscle fascia are stretched over the cord and carried into the scrotum as the external spermatic fascia. It is only after the removal of this layer that the so-called superficial inguinal ring comes into view.

The lower margin of the aponeurosis is greatly thickened and forms a grooved band towards the abdominal aspect, as it fuses with the aponeuroses of the deeper muscles. It forms a prominent arched

structure called the Inguinal or Poupart's ligament, due to its attachment to the fascia lata below. This inguinal ligament is broader medially and laterally as it fuses with the fascia pectinea and fascia iliaca respectively, thus forming semilunar margins bordering the femoral sheath on either side (Fig. 5).

Certain structures in this region are spoken of as extra insertions of this aponeurosis. They are (1) the pectineal part of Inguinal ligament or lacunar or Gimbernat's ligament (2) the pectineal ligament or ligament of Astley Cooper (3) Reflex inguinal ligament. I am of the opinion that the inguinal ligament represents not only the fused lower margins of the aponeuroses of all the three anterior muscles, but also the fused edge of the fascial investments of the posterior and anterior abdominal muscles in that region. More will be said about it when the formation of the femoral sheath is discussed. These so-called extra insertions like the lacunar ligament represent the fused pectineal fascia with the inguinal ligament. The reflex inguinal ligament is really the lowest oblique fibres of the aponeurosis of the other side interlacing through the linea alba and passing over to reach the pubic crest on the opposite side. The name is a misnomer. Very often it is absent.

### M. OBLIQUUS INTERNUS

In our series, the muscle arises from the entire inguinal ligament and not from its

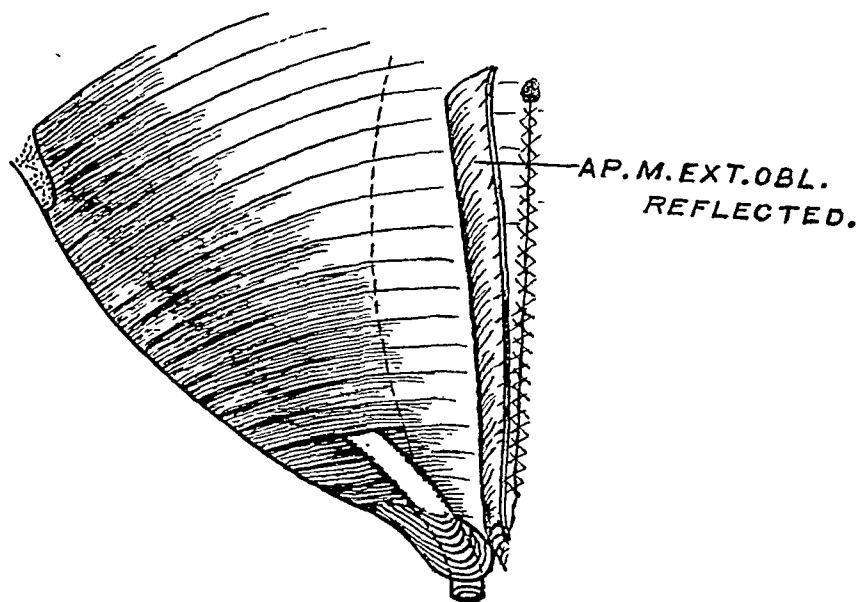


Fig. 2.  
M. Int. OBL. arising from entire Ing. Lig.

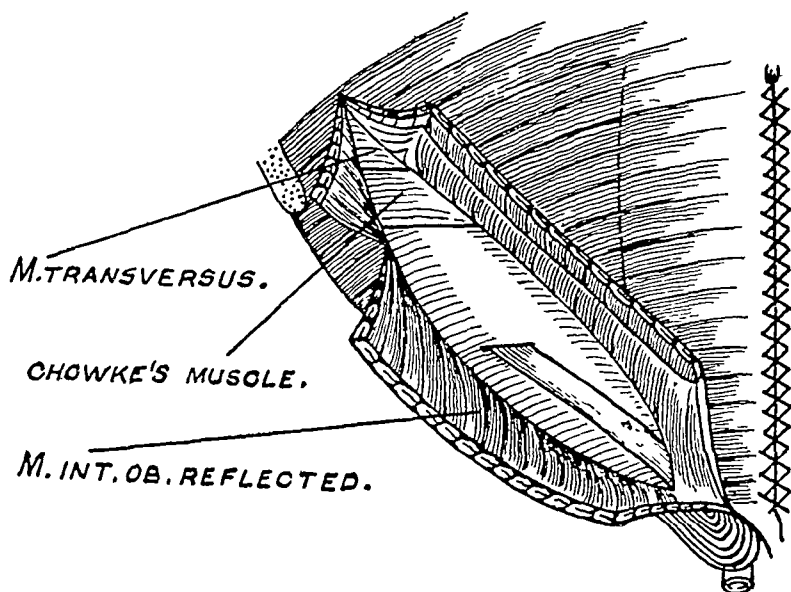


Fig. 2a.  
M. Transversus ABD. and Chowke's muscle.



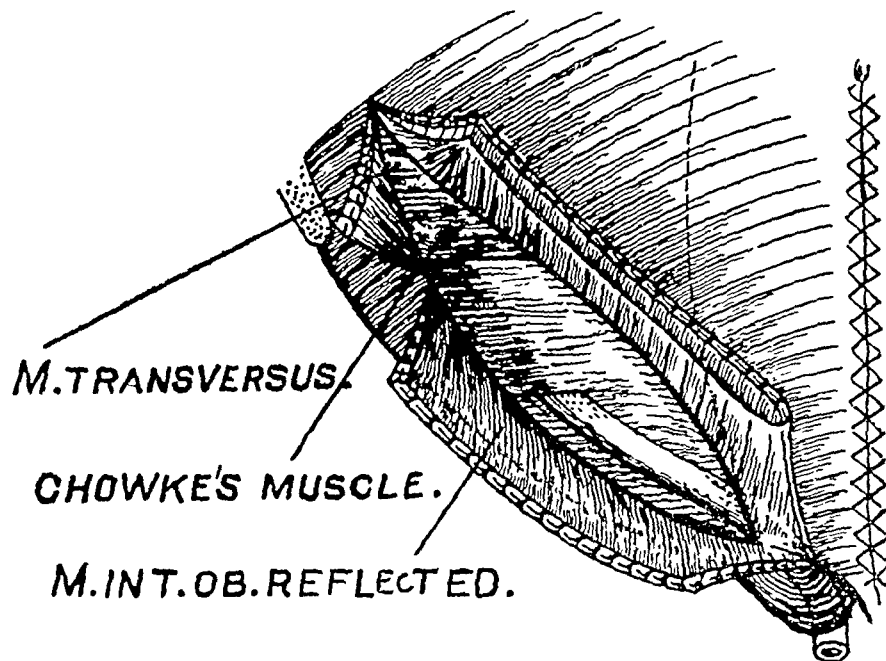


Fig. 2a.

M. Transversus ABD. and Chowke's muscle.

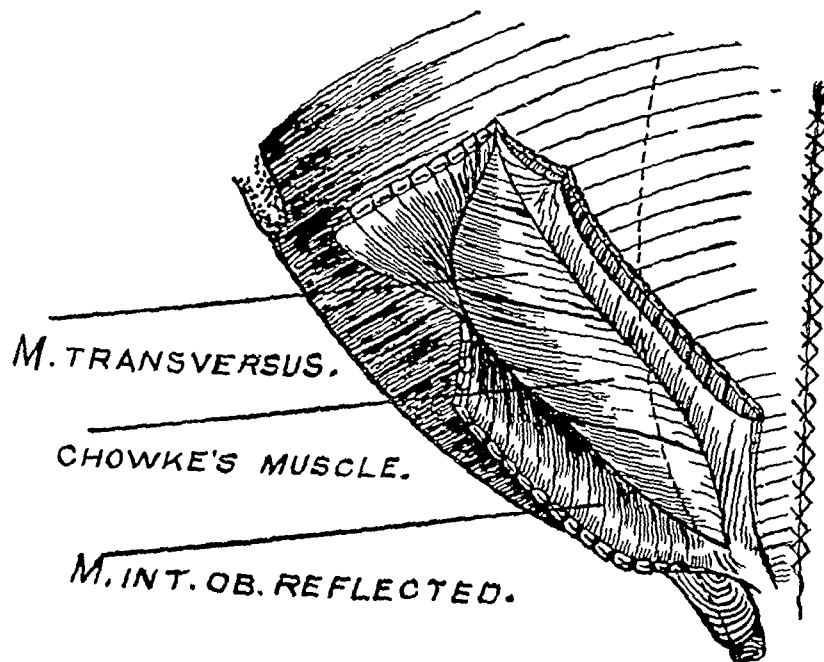


Fig. 2a.

M. Transversus ABD. and Chowke's muscle.

lateral half only as described in the books. As such there is no arch formation in its lower part. The lowest fibres, arising from the grooved upper surface of the inguinal ligament, pass horizontally across, to reach the linea alba in front of the rectus sheath. Often, muscle fibres are seen to reach beyond the external ring. The muscle arises from a wide area of the iliac fascia also. The muscle is often broken into bundles with intervening clear spaces of muscle fascia. Many a time it is blended with the *M. Transversus*. It is pierced by two nerves, *viz.* genital branch of the genito-femoral nerve and the ilio-inguinal nerve, which join the cord just before the latter pierces the external ring. The spermatic cord pierces this muscle just lateral to its exit in the external oblique and as it really evaginates the muscle, it carries a few muscle-fascicles and the muscle fascia as one of its coverings *viz.*, the 'cremasteric fascia.'

In half the number of cases examined, irrespective of the sex, or the general musculature of the body, this muscle was thick and showed variable stratification. The deeper layer was broken into one or more fleshy bands which were first described by Chowke as accessory internal oblique muscles. This Chowke's Muscle is very variable. It may be present on one side only or present on both sides. Statistical analysis has not been worked out in our cases as to its presence or absence, the number and so on. When present, this muscle is always found near the level of the anterior sup: spine or above it. It has a separate tendon of insertion to the rectus sheath.

In only 20 per cent of our cases, the internal oblique was aponeurotic below the iliac spine. In no case was there any arched lower margin over the deep ring as described in the books. Transillumination of this region in cases where this muscle was replaced by fascia, showed that the fascial continuation contained aponeurotic fibres.

Though, in the majority of cases, the aponeurosis of the internal oblique passed

in front of the rectus sheath without fusing with it, in a few cases, it was found, that the aponeurosis fused early with that of the *M. transversus* and the combined structure formed the rectus sheath. In a few cases the internal oblique split into two lamina which enclose the rectus muscle as in the supra-umbilical region. Essentially, therefore, there was no difference in the relation of the aponeurosis to the rectus above and below the mid point between the umbilicus and symphysis.

### M. TRANSVERSUS ABDOMINIS

This muscle presented considerable variations. In a large number, the muscular fibres extended down to the inguinal ligament and medially as far as the rectus muscle. Generally speaking it was less muscular than the internal oblique muscle. Like the internal oblique, in those cases of attenuation, the muscle fascia and its aponeurosis could be traced to the ligament and often it blended with the fascia transversalis on its deep aspect. The aponeurosis divided at the lateral margin of the rectus muscle into three laminae. The middle lamina split again to form an internal sheath and the outer and inner most layers passed in front and behind to form a second sheath for the rectus abdominis (Fig. 1). The posterior layer was so thin that the aponeurotic fascicles were spread apart to form the so-called arcuate lines behind the rectus muscle. As many as four arcuate lines or semilunar folds of Douglas could be counted behind the rectus below the umbilicus. The number of such arcuate lines were not constant and were different on the two sides in the same subject.

In all cases the transversus muscle and its aponeurosis were pierced by the cord and a tubular prolongation was carried over the cord into the scrotum. The lower fibres of the muscle formed the distinct cremasteric muscle. Medial to the point of entry of the cord, the aponeurosis passed to the lateral margin of the rectus to form its sheath. In only 5 or 6 cases was there a formation of falx when seen through transilluminated light. The tendinous fibres

were seen to run obliquely downwards in bundles behind the cord to reach the ilio-pectineal line. These are described in the text-book as the conjoint tendon, Hesselbach's ligament and other bands.

### M. CREMASTER

This muscle is either formed by the lowest fibres of M. internal oblique or by M. transversus. In either case the fibres are carried on into the scrotum as the muscle fascicles of the cremasteric fascia. It has no special tendon of insertion as described in books. It is just a few muscle fibres of the inner two muscles which are stretched and carried over into the scrotum when the cord evaginates these muscles in succession.

### FASCIA TRANSVERSALIS

This, in my view, is to be considered as the membranous layer of the extra-peritoneal fatty tissue just as the fascia of Scarpa is the membranous layer of the subcutaneous fat in this region. This is not the muscle fascia on the posterior aspect of the

transversus muscle as some authors believe. When the muscle is degenerated as it often is, the muscle, fascia, the aponeurosis of the transversus muscle and the fascia transversalis appear to blend. With transillumination light, in such cases, the fascia transversalis appears to have certain thickened parts, which have been variously described as Henle's band, Henle's ligament, Interfoveolar ligament of Hesselbach, Thompson's ligament and so on. These different structures are really due to the aponeurosis of the transversus abdominis. They come to greater prominence when the aponeurosis of the internal oblique muscle fuses early with that of the transversus muscle as described above.

The fascia transversalis is attached to the whole length of the inguinal ligament and passes on to the posterior wall as a continuous fascial lining. It is not carried into the thigh over the femoral vessels as the anterior layer of the femoral sheath. So, as described before, the abdominal cavity is a closed fascio-aponeurotic cavity, inside which, is the serous cavity of the perito-

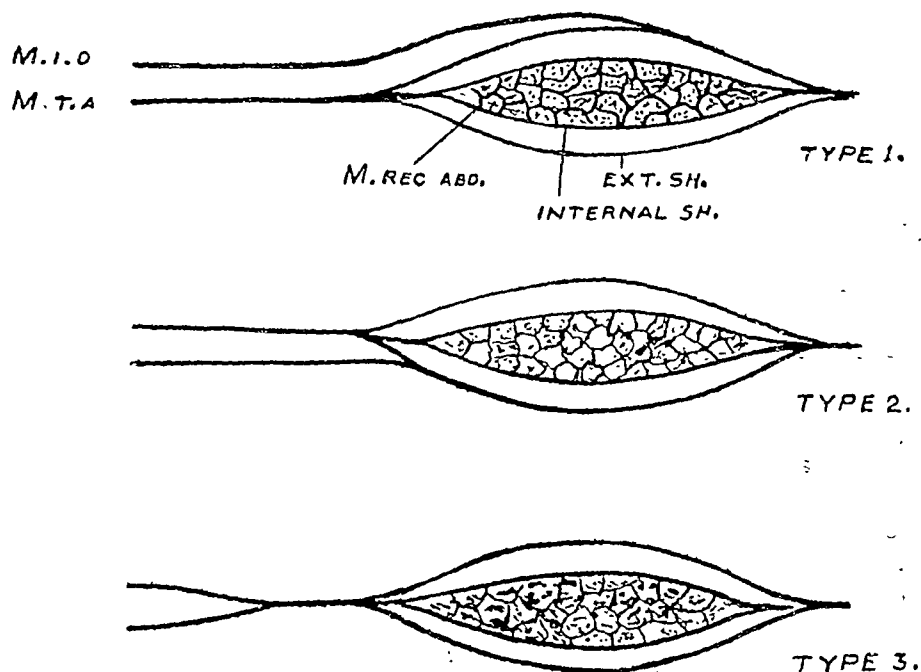


Fig. 3.

Types of Rectus Sheath.

neum. Injection experiments clearly showed that the fascia transversalis never passes into the thigh and it directly becomes continuous with the fascia on the posterior wall.

Careful dissection of the inguinal region and a study of sagittal sections show that the inguinal ligament is a composite structure derived from fusion of the fascias of the abdominal muscles and fascia transversalis. There is only one compartment for the vessels and lymphatics behind it and through this the extra-peritoneal fatty space of the posterior abdominal wall in which the iliac vessels run, is carried into the femoral sheath (Fig. 5). Figure 4 shows the schematic drawing of a sagittal section across this region.

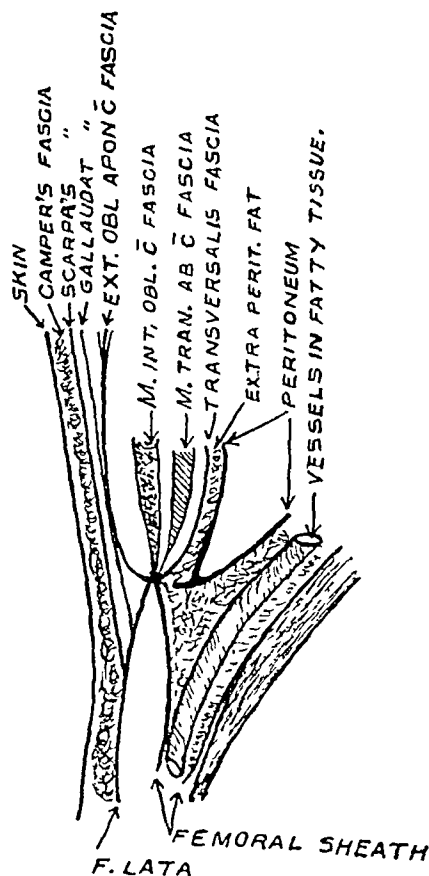


Fig. 4.

Vertical Section thro' Inguino-Femoral Region.

Certain structures like the Falx inguinalis, Hesselbach's ligament, and certain artefacts like the inguinal canal have acquired exaggerated importance, though they rarely exist. Some have been variously described as thickenings in the fascia transversalis, or extra attachments of inguinal ligament and so on. So they need in my view, further discussion,—though they have been mentioned before,—as to their nature and relations.

## 1. CONJOINT TENDON OR FALX INGUINALIS

It is conventionally described as 'the conjoint tendon of the internal oblique and transversus muscles and inserted into the crest and the pectineal line of the pubis behind the superficial ring'—GRAY (1940). From the above description of the muscles, it is seen that it is absent in a large number of cases; and when it exists, it is more fascial than tendinous. Out of 50 cases examined, in only 5 cases was there any thing like a falx. Even in these cases, there was early fusion of the aponeuroses of the two muscles but the lower part of this fused layer splits into two laminae. The anterior passed in front of the rectus muscle and the posterior passed behind and downward towards the pectineal line to form a 'conjoint tendon.' So the falx is rarely present. Either the lateral sickle-shaped margin of the rectus muscle, or the fused tendinous margin of the rectus and its sheath, or merely the down-turned aponeurotic fascicles of the two muscles are recognised by different authors as the falx. German authors call the lateral margin of the rectus and its sheath as the Falx. English books call the conjoint aponeurosis as the Falx.

## 2. HESSELBACH'S INTERFOVEOLAR LIGAMENT

Anson is of the opinion that it is a condensation of the connective tissue round the obliterated umbilical artery. From our study, we believe it to be an isolated bundle of aponeurotic fibres of M. Transversus which takes a curved course towards the inguinal ligament and appears as a distinct

band. It is conspicuous by its absence in a large number of cases. It is not the thickened part of the Fascia Transversalis as some authors would suggest.

### 3. HENLE'S BAND, ETC.

Henle's band, Henle's ligament, Thompson's ligament, etc., are also very rarely seen. They appear as thickened isolated entities due to the scattering of the aponeurotic fibres of the muscle transversus or in early fusion of the two aponeuroses from the conjoined aponeurosis. Their morphology is the same as Hesselbach's ligament. They are not thickened parts of Fascia Transversalis. The last named structure is the expanded medial part of the Inguinal ligament and pectineal fascia.

### 4. RECTUS SHEATH

The mode of formation of this sheath, as described in the text-books, is too well-known to be repeated here. From the previous paragraphs on the muscles, it is seen that our observations are at variance with this conventional view. We believe, with Anson, that the transversus forms in most cases, the sheath for the rectus and that this sheath is double—an internal and an exter-

nal one. The schematic drawings in Fig. 3 give, from our point of view, this arrangement of the aponeuroses of the internal oblique and the transversus. Type I is the most common variety. There are shown the three lamellae into which the aponeurosis of transversus splits at the lateral margin of the rectus and the way they form the two sheaths for this muscle. The other types are the rarer varieties. Type II is the rarest, where the Internal oblique is seen to split into the three layers, which form the sheaths. Type III is more frequently met with where the aponeuroses fuse far lateral to the rectus and this fused layer splits into the 3 lamellae.

Another point of disagreement with the text-book view is as to the vertical extent of the posterior wall of the sheath. The conventional view is that, below the point midway between the umbilicus and the symphysis, the rectus has no sheath behind and therefore it rests directly on the fascia transversalis; for from here all the three aponeuroses pass in front of the rectus. This abrupt termination of the posterior layer is said to form the linea semicircularis. In a previous para on M. Transversus it is shown that this view is untenable. In all cases,

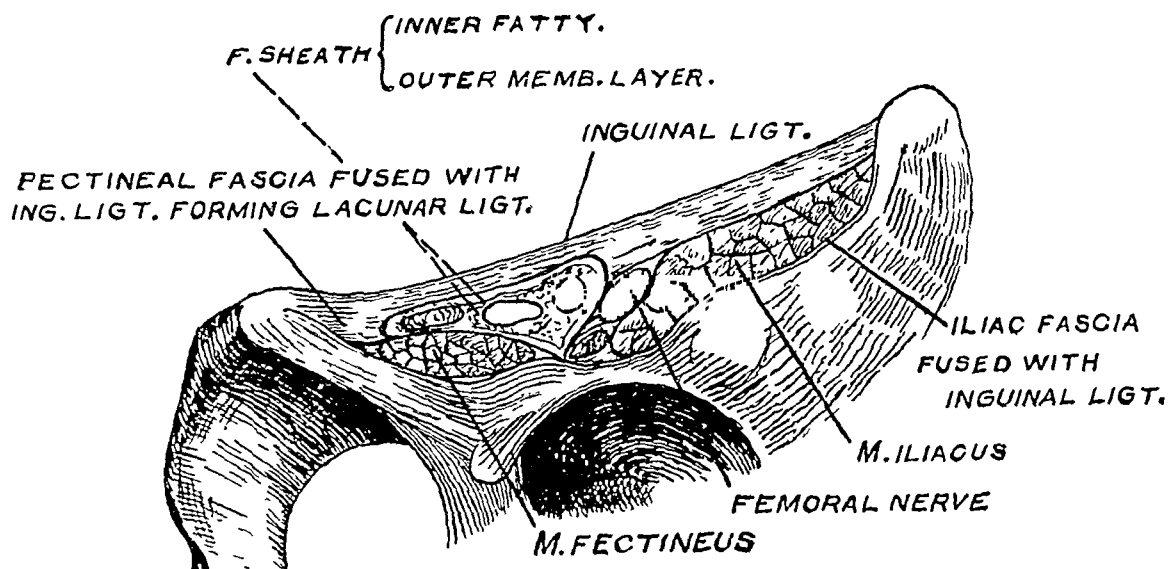


Fig. 5.

Section Through Inguino-Femoral Region Parallel to Inguinal Lig.

Note there is only one Lacuna for vessels.

the posterior layer of the sheath is complete and that this is either composite or mainly from the transversus. At the linea semicircularis, this wall gradually thins out towards the caudal side, and its aponeurotic fibres are few and scattered to form a number of arcuate lines as previously discussed.

### INGUINAL TRIANGLE OF HESSELBACH

This triangle is situated medial to the epigastric artery and lateral to the rectus muscle. It is said to have different relations, medial and lateral to the interfoveolar ligament and the coverings of a hernia in this region is said to be different from those of an oblique hernia occurring through the deep ring. But from the above description, it is seen that there is no essential difference. All hernias, whether direct or indirect, will have the several layers of the abdominal wall as their coverings.

### INGUINAL CANAL

Since the three muscles of the anterior abdominal wall, extend down to the inguinal ligament, the usual description of the existence of an inguinal canal, is not tenable. The idea of a Musculo-fascial canal obliquely running from the deep ring to the superficial ring, and having the internal and the transversus muscles as the roof structures will have to be discarded as it is based on artefacts.

The relation of the testis to the several layers of the anterior abdominal wall is essentially the same as that of a nerve or an artery, which passes through the several layers to become subcutaneous. The testis during its descent, evaginates successively the several layers of the ventral body wall. It is formed in the intermediate cell mass and lies in the extra-peritoneal connective tissue in the dorsal wall. To gain the superficial subcutaneous position in the ventral body wall, i.e., the scrotum, it has to successively evaginate all the superficial layers lying in front of it, namely, the fatty and the membranous layers of extra-peri-

toneal tissue (fat and fascia transversalis), the muscles of the body wall or their attenuated fascias and finally lodge in the subcutaneous tissue of the scrotum.

In this process of migration there is nothing peculiar nor is the method any different from the way the dorsal vessels and nerves gain the superficial subcutaneous position in front. During the migration of the testis, the anterior wall is greatly expanding, and the ventral muscle sheet will be delaminating into the various muscles. What was one antero-posterior opening in the ventral wall, is drawn out by this relative shifting of the structures, so the testis will have 4 successive openings in the four strata of the ventral body wall, i.e., fascia transversalis, and the three muscle layers or their representatives—the aponeuroses. Moreover it must be clearly understood that these openings are really artefacts in as much as the greatly expanded and evaginated parts of these layers are in the scrotum as coverings of the testis and they come into existence when these funnel-shaped evaginations are cut through. The conventional description of the inguinal canal as being triangular in section and having a roof, a floor and, walls, etc., will have to be discarded. This migration is in my opinion, only an exaggerated mechanism by which the other structures like the inter-costal vessels or nerves of the abdomen become subcutaneous. They also successively evaginate the several layers and may be said to carry them as tubular sheaths. The only difference is that, to facilitate the passage of such a big structure as the testis, nature provides a bursal precursor—the saccus vaginalis, under which the testis slides easily down—and a gubernacular musculo-fibrous structure to guide it into the scrotum. Even this latter factor is being questioned now, as the testis is supposed to descend primarily as a result of hormones and intra-abdominal pressure.

This conception of the inguinal region perhaps greatly modifies the current view on the etiology and the pathogenesis of inguinal hernias. I believe that those individuals, who have the muscle strata greatly

reduced in this region are potential subjects for hernias. Secondly in such subjects the obliquity of the four openings is not so great. Probably these are close so that increased intra-abdominal pressure may abnormally push a loop of intestine through this weak part. The different levels of the openings, the distances between them and the differently directed muscle fibres of the muscles will normally act as shutter-like valves against any tendency for herniation. Also the muscle fibres around the openings may act as sphincters of these openings and relatively shift them and oppose them. In those people in whom the muscles are represented by their fasciae only, all these functions are lost and so the wall is greatly weakened. Any abnormal increase in the intra-abdominal pressure will then produce a hernia. Similarly in the inguinal triangle, the hernias (direct) are scarce because the internal oblique and the transversus muscles are muscular in most cases. It is only when they are fascial, that there is a tendency for hernias. The surgical implications of such a concept as the one discussed above will be dealt with in a separate paper.

### SUMMARY AND CONCLUSIONS

The following conclusions are arrived at from a study of the inguinal region in the local dissection material:—

1. The muscles—the internal oblique and transversus abdominis—have attachments along the whole length of the inguinal ligament.

2. Even when they are non-muscular, one can trace their aponeuroses to the ligament.

3. The Fascia transversalis is not the muscle fascia of the transversus abdominis but it must be considered as the membranous layer of the extra-peritoneal fatty tissue.

4. There are four openings in the anterior abdominal wall for the passage of the testis and cord. Two of them are named the internal and external rings. The inter-

mediate ones in the inner two muscles are not named.

5. An inguinal canal of conventional description is not present.

6. The Rectus abdominis has a complete double sheath from the Xiphisternum to symphysis, derived from the aponeurosis of transversus abdominis. The text-book description that, below the mid-point between symphysis and umbilicus, there is no posterior layer of the rectus sheath is not borne out in our cases. There is essentially no difference in the formation of the sheath in the two areas. The external and internal oblique do not really contribute in a large number of cases to the formation of the sheath.

7. The conjoint tendon, Henle's band, etc., are all thickened parts of the aponeurosis of the transversus abdominis. In cases where there is early fusion of the aponeurosis of the internal oblique and transversus, these may become more conspicuous. Normally they are conspicuous by their absence.

8. The femoral sheath is not formed by the fascia transversalis and the fascia iliac as described in books. It has two strata. An inner sheath derived from the fatty tissue round the vessels and an outer layer derived from the connective tissue of the thigh. The fascia transversalis is attached to the entire length of the inguinal ligament and does not pass into the thigh.

9. There is only one lacuna under the inguinal ligament as the inguinal ligament fuses with the fascia iliaca laterally and the fascia pectinea medially.

10. The abdominal cavity must be looked upon as a closed musculo-fascial connective tissue space inside which there is a closed serous cavity.

In conclusion I acknowledge the great help rendered by my assistants in making the special dissections. Special thanks are due to my former assistants Dr. T. Manickam, M.B.B.S. and Dr. S. T. Puttanna, B.Sc., M.B.B.S.

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RECURRENT DISLOCATIONS OF THE SHOULDER JOINT

by N. S. NARASIMHAN, F.R.C.S. (Eng.), Surgeon, Madras General Hospital, and Prof. of Operative Surgery, Madras Medical College.

Recurrent dislocation is fairly common in Madras. This paper is based upon a critical study of 99 cases treated during the seven years 1938-45. The prevailing ideas regarding the causation, incidence and pathological features are reviewed in the light of our experience.

The condition is mentioned by Hippocrates but the first accurate description was given by Dupuytren.

In a study of recurrent shoulder dislocations one should consider (1) anatomical mechanisms (2) pathology and morphology and (3) treatment (operative and non-operative) with an assessment of results.

In the study of the mechanism it is well to review some anatomical points. Magnusson and others dissected 21 shoulders to demonstrate this region and they were impressed by the size and strength of the ligaments in fresh post-mortem specimens. The coraco humeral ligament strengthens the superior aspect of the joint, and the inferior gleno-humeral ligament strengthens the lower and anterior part of the capsule which is situated above the quadrilateral space. The description of these ligaments as weak bands is an illusion produced in

the fixed anatomical specimens of the dissecting room. These dissections also demonstrated that the anterior capsule is always attached to the rim of the glenoid cavity and is never attached to the neck of the scapula. Radiographic examination after injection with lipiodol confirms this point.

The long head of the biceps is an important factor in the mechanism of the shoulder joint. At its attachment to the scapula, the tendon divides into three parts, viz., a large intermediate part which obtains direct attachment to the scapula and two smaller collateral parts which diverge from each other and blend with the labrum glenoidale. The long head of the biceps on account of its intraarticular position and its situation in the deep sulcus between the tubercles of the humerus is a very important factor in keeping the head of the bone in place and in steadying it in the various movements at the shoulder joint.

In the cadaver the head of the humerus could not be completely dislocated, even though all the muscles and the capsule were severed.

*Mechanism causing dislocation:* The shoulder is in maximum internal rotation



when the arm is abducted until it is level with the shoulder, elbow flexed to  $90^\circ$  and the forearm pointed straight down. Further elevation of the elbow from this position is impossible due to locking of the greater tuberosity against the upper rim of the glenoid fossa of the scapula. Forcible elevation of the elbow above this point may result in an inferior dislocation or fracture of the greater tuberosity with a dislocation or a triple fracture involving greater tuberosity, head and shaft. What actually happens depends on the nature of the injury.

In an ordinary dislocation due to indirect violence, the head is forced through the lowest and weakest part of the capsule between the subscapularis muscle above and the long head of the triceps below. This has been verified in post-mortem examination. A typical sub-coracoid dislocation was first produced in the cadaver by Davies in 1899.

In a fall backwards, when the patient stretches out the arm to break the fall, dorsal extension of the arm is limited by the locking of the head of the humerus against the spine of the scapula at the point where it joins the acromion. Further forcible extension results in fracture of the shaft of humerus or an anterior dislocation, the head being pushed through the joint capsule dissecting the subscapularis from its attachment to the scapula.

This dislocation following dorsal trauma tends to recur because the movement of backward extension is frequently repeated in every day life. It has, however, been noted in our series that the interval between the two dislocations varied from a few days or weeks to as long as 15 years.

The greater tuberosity is pulled off in some dislocations. This occurs in severe injuries in patients who are rather muscular. This would suggest that one of the factors that prevent the head from going downwards and forwards is tension in the supra-spinatus and infra-spinatus muscles with some tension in the teres minor.

*Theories of recurrent dislocations:* The normal protective mechanism against dislocations are:

(a) Structural factors such as the anterior part of the limbus, the anterior rim of the glenoid fossa and the anterior attachment of the capsule.

(b) The physiological protection of the subscapularis. Changes such as thinning out and relaxation of the subscapularis have been described as occurring in recurrent dislocation but have not been seen in any of our operated cases.

*Bankhart's theory:* Bankhart's classical description of the two varieties of dislocation caused by direct and indirect violence is given in the Robert Jones Birthday volume.

Dislocation by *direct violence* is caused either by a fall on the back or front of the shoulder, or upon the point of the elbow while it is directed backwards or forwards. The head of the humerus in the former case is displaced not by leverage, but by a direct force which shears off the capsule from the fibrocartilaginous glenoid ligament and which frequently detaches the glenoid ligament from the bone. The detachment occurs practically over the whole of the anterior half of the glenoid rim. In a dislocation due to *indirect violence* the rent in the capsule heals rapidly and soundly but in that due to direct violence there is no tendency for the detached capsule to unite spontaneously with the fibrocartilage. The defect in the joint is therefore permanent and the head of the humerus is free to move forwards over the anterior rim of the glenoid cavity on the slightest provocation. This type of dislocation is liable to be associated with extensive laceration of the soft parts and with fractures of the neighbouring bones. These latter are due to the direct injury which produces the initial dislocation.

The essential feature in a recurrent dislocation is thus the detachment of the capsule from the fibro-cartilaginous glenoid ligament. From this pathology, Bankhart concluded that the treatment of recurrent

dislocation is operative and consists in re-attaching the fibrous capsule to the glenoid ligament or fixing it to the bone at the anterior margin of the glenoid cavity.

Bankhart's views regarding the pathology have been more or less widely accepted but other views have been put forward at various times. The more important among them are :

1. Defects in the head of the humerus, either congenital or acquired after the first dislocation.

2. Defects in the glenoid cavity, e.g., shallowness of the congenital type or a fracture at the edge.

3. Rupture of the insertion of the external rotators of the humerus.

4. Avulsion of the greater or lesser tuberosity of the humerus, with or without rupture of the external rotator muscles. Tear of the supra spinatus and infra spinatus muscles in the original dislocation, may lead to loss of the supporting action. Duchenne has stated that recurrent dislocation cannot occur, unless the supra-spinatus tendon has been ruptured. We have, however, not seen it in any of our cases.

5. Detachment of the joint capsule from the anterior margin of the glenoid.

6. Capsular relaxation, either congenital or following tears which have not been given sufficient time to cicatrise or again due to repeated stretchings without actual tear. Jossel in one case injected the capsule with mercury and found its capacity to be three times as great as the normal.

7. Failure of neuro-muscular co-ordination (Codman).

Nearly everyone who has studied the subject has admitted that fracture of the glenoid rim especially the anterior margin with capsule laceration may favour habitual dislocation.

Hildebrand reported from Berlin 18 cases (3 bilateral) during the years 1913 to 1925. In these 21 shoulders, there was definite radiographic evidence of bony defect in the

head of the humerus in 15 instances. The defect may be a congenital one leading to habitual dislocation or it may be the result of the dislocation. There may be a complete or partial posterior notch—a wedge-shaped notch on the posterior aspect caused by the striking of the head against the glenoid margin when luxation occurs.

Patrick and Didee (1930), Gregoire and Bazy described the X-ray technique for demonstrating the lesions of the head of the humerus and demonstrated deformities of the head in every instance. We have not been able to demonstrate the defect in our cases and an examination of 50 unselected humeri from the Anatomy Department of the Madras Medical College showed one humerus with a notch.

In recurrent dislocation there need not necessarily be a tear of the capsule to permit the head to leave the socket, and soon after reduction of the recurrent dislocation, the patient is free from pain because there is no inflammatory reaction.

Gallie believes that recurrent dislocation is caused by a defect in the inferior gleno-humeral ligament and treats the condition by creating a new inferior gleno-humeral ligament, which will prevent the head from gliding downwards and forwards when the appropriate leverage is applied.

*Theory of muscle imbalance.*—Paul B. Magnusson records an instance of twin brothers with recurrent bilateral dislocation of the shoulder. An elder brother had the same condition and the father and father's brother also had the same history. This incidence in several members of the same family suggested an anatomic weakness or muscle imbalance inherent in some individuals which permitted the condition to occur without severe trauma. Magnusson while admitting that the pathology of the tear of the glenoid labrum may be present in some cases does not believe the tearing of the anterior lip of the glenoid with a gap in the capsule at the point of tearing to be a cause. Magnusson does not repair the capsule because he thinks it is an exceedingly lax membrane and not worth repairing.

The postural tone of the muscles is important in preventing a dislocation. The stability of the shoulder joint depends on the muscles supporting it. In the shoulder joint, the ligaments are not as strong as the hip. A large rounded head articulates with the shallow glenoid which contacts only a small portion of the head. In these respects it differs from the hip where the depth of the acetabulum and the strength of the ligaments form the main support. In cases of muscular paralysis the head of the humerus drops away from the glenoid and lies well below it while with all the muscles paralysed, the strongest traction cannot pull the head of the femur out of the acetabulum. Can lack of muscle balance or muscle leverage to resist the downward and forward movement of the head be a contributing factor in the causation of recurrent dislocation?

The large incidence of recurrent dislocations in epileptics and the occurrence of dislocation during an epileptic seizure also suggest that muscle imbalance and muscle leverage may have something to do with the occurrence and recurrence of downward and forward displacement of the head.

In one out of nine operated cases Magnusson found that the tendon of the subscapularis was entirely free from the capsule instead of blending with it as is normal. When the arm was abducted and extended, the tendon slipped up between the head of the humerus and the glenoid and did not afford any support to the anterior capsule. This abnormality, however, was not found in the case of the two epileptics in the series.

There is no mention in the literature of a comparative study having been made of similar recurrent dislocations occurring in other joints. It would appear that there is no one common cause which can account for recurrent dislocations occurring in these joints.

In the case of the recurrent dislocation of the patella, it is the weakness of the quadri-

ceps, especially the vastus internus component, which is the important factor. Other factors such as imperfect development of the patella or of the external condyle, traumatic or pathological lesions of the internal ligament or genu valgum may be responsible for a few cases.

It is interesting to note that this condition shares with recurrent dislocation of the shoulder the reputation of having the greatest variety in the number and nature of operations recommended for its relief. Here also we see that operations on bones, on ligaments and on capsular structures have all been tried.

Several operations are used such as re-implantation of lateral half of ligamentum patellae into the medial side and attachment of the semi-membranosus tendon to the medial half of the ligamentum patellae.

Subluxation of the sterno-clavicular articulation, sometimes bilateral and recurrent dislocations of the temporo-mandibular joint seem to have this factor in common that the removal of the inter-articular cartilages cures the conditions.

The 99 recurrent anterior dislocation cases studied occurred in a total of 206 shoulder dislocations treated during the period under review and were distributed as follows:—

Age	Right		Left		Bilateral	Total
	Male	Female	Male	Female	Male	
5--10	1					1
11--20	14	1	2			17
21--30	27	—	20		2	49
31--40	13	1	3		2	19
41--50	5		3			8
51--60	3					3
61--70	1					1
71--80	1					1
Total ...	65	2	28		4	99

The primary dislocations (two posterior and the rest anterior) were distributed as follows:—

AGE INCIDENCE

Age	Right		Left		Total
	Male	Female	Male	Female	
5-10	3	1	1	—	5
11-15	5	1	1	—	7
16-20	11	2	8	—	21
21-30	53	5	15	2	75
31-40	38	5	10	—	53
41-50	15	1	9	1	26
51-60	7	2	3	1	13
61-70	1	—	—	3	4
71-80	1	1	—	—	2
Total ...	134	18	47	7	206

It will be noticed that the incidence in the third decade is highest in both cases being 50% in the recurrent ones. Bankhart gives the highest incidence at the fourth decade. The youngest case was seen in a boy of 10 whose first dislocation occurred in hospital during a tetanic spasm. It was easily reduced but recurred during subsequent spasms. On discharge from the hospital, the shoulder was normal but the patient was not heard of again. Only five cases of recurrence were seen in patients above 50 years of age—an observation which raises the question whether the condition cures itself as age advances.

*Sex.*—Only two out of 99 recurrent cases were seen in females as against 25 out of 206 traumatic cases. Tavernier (1929) remarks "it is a striking fact that the proportion of recurrent dislocations among females is twice as great as the proportion of primary luxations."

*Nature of injury.*—It has been stated (Hobart and Bankhart) that the initial injury is always a violent one, the thrust being produced by the patient's own weight. In the cases under consideration, the primary dislocation was usually caused by comparatively minor trauma such as "fall on slippery ground" "while bathing" "during dandal exercises" and each successive recurrence was produced by even less trauma. The thrust produced by the patient's weight could hardly be called excessive, as the patients in this series were

comparatively small in stature. The fact that repeated recurrence was seen in a boy of 10 during tetanic spasms and the fact that 67% of recurrences were in the right shoulder, leads one to believe that lack of muscle control is a deciding factor in recurrence.

*Occurrence in epileptics.*—Seven patients were epileptics and one of them had bilateral recurrences. This number (approximately 70%) does not agree with the larger percentages given by other observers, "who comment on the great liability to recurrent dislocation manifested by epileptics and athletes." (Tavernier—1929.)

*Operative findings.*—Of the 99 cases of recurrent dislocation 16 (all males and only one epileptic) have been operated on and the opportunity was taken to study the pathology. On account of the want of a history of the typical dorsal type of injury in our recurrent cases, one was sceptical of the pathology as described by Bankhart. Particular attention was paid to the following points in an effort to study the pathology:—

1. Capsule attachment, capacity and tears.
2. Glenoid cavity and labrum.
3. Humeral head.
4. Muscles.

1. The capsule was never found to be lax and, in fact, was even tighter than in the cadaver. Our experience is that even cases of infantile paralysis in whom subluxation could be produced by allowing the arm to hang by the side, showed no laxity of the capsule, and no dislocation could be produced when the anaesthetised patient was on the table with the arm unsupported. This is in accordance with Henderson's statement that "these dislocations are difficult to produce by passive motion even in a habitual case under an anaesthetic." He thinks that voluntary muscle action is necessary. In the 12 Bankhart's cases, tears were seen in the anterior part of the capsule in eleven but in one case there was no proof that the head had left the capsule,

2. The glenoid labrum was found detached from the glenoid margin in its central part in eleven cases.

3. No abnormality of the humeral head was seen. The notch and hatchet deformity described by A. L. Eyrebrook as occurring on the posterior surface of the head are not demonstrated by the anterior approach to the shoulder. However no abnormality was discernible in routine X-rays taken with the arm abducted to 90°. It is a moot point whether such deformities are the cause or the effect of recurrence. A. L. Eyrebrook (1942) was able to obtain the first specimen of a known case of recurrent dislocation of the shoulder in a post-mortem examination. In that specimen the notch and the defect on the anterior margin of the glenoid cavity are the effects of trauma. This specimen does not provide any support for or against Bankhart's view. Tavernier states "that the notch was widely recognised when resection of the joint was the only operation employed for the condition (from 1882 to 1913 — 12 authors). All authors stress on the absence of loose bodies in the joint and use the absence of such loose bodies as an argument against trauma being the cause of the notch. The notch is not due to crushing injury because the texture of the bone is normal in radiographs.

4. Muscles and ligaments. No tear of the supra spinatus or of the gleno-humeral ligaments was observed and in all cases the subscapularis was well developed and adherent to the anterior capsule. The tone of the other muscles was good.

Erut Detric of North West University, Chicago, found the following condition in every shoulder explored for recurrent dislocation between the years 1938—1944. The limbus glenoidalis had torn loose from its attachment to the anterior circumference of the joint, and had remained loose. In one case, an epileptic, he found that the dislocation was reduced but would not stay in place. When the joint was explored, the cause was found in the position of the limbus. The anterior half had torn loose and was dislocated into the posterior section of

the joint like a bucket handle injury of the meniscus. The anterior rim of the glenoid fossa was found levelled off, rough and denuded of cartilage. In some other cases, the rim was found fractured. A false joint cavity was found between the anterior surface of the scapula and the subscapularis. This cavity forms as the head of the humerus tears the muscle loose from its attachment. This was found in every case. The cavity either communicated with the joint or was separated only by weak adhesions.

Fractures of the anterior rim of the glenoid and typical defects above the lesser tuberosity have been seen in some cases. These were not associated with any pain or limitation of movement.

Barker and Wood's method of manipulation was tried in recurrent dislocation cases unwilling to be operated on without any benefit.

*Non-operative conservative treatment:* Occasionally shoulders which have dislocated two, three or four times will under the dog-collar method of check, lose the habit and the patient will not have further trouble.

*Operative treatment:* The operative procedure adopted was that of Bankhart except in two cases where Clairmont's operation was done and 2 other cases in which Nicola's procedure was adopted.

*Technique of Bankhart's operation.*—The anterior approach gives a good exposure. Suturing the limbus to the glenoid fossa using holes drilled through the bone is technically very tedious and mechanically not satisfactory because the sutures tend to cut through the cancellous bone. Magnusson advocates the use of a screw and washer placed obliquely through the neck of the scapula to attach the limbus and capsule to bone. Bankhart used a sharp volsellum to work through the bone to make holes in the bone margin. These holes were used to fix the capsule and cartilage flush with the anterior rim of the glenoid. This part of the operation is always very difficult. Insertion of metal staples has been recom-

mended and practised but these have a tendency to work their way out. Moroney (1945) used the dental drill with the slot and pig-tail guides made by Messrs. Down Bros. Bankhart himself now uses a dental drill. We also have changed to a dental drill but without guides. The procedure is not easy. After the holes have been drilled it is still difficult to pass a needle through them. The ordinary curved needle is too curved to pass easily and one which is bent at right angles on a long handle as described by Bankhart would be more easily manipulated. It is so set that when the eye faces the surgeon, the handle is deflected 45° to the right and is out of the way. Ollerenshaw's modification of Murphy's "hipskid" is described by Bankhart as a "most useful, if not essential instrument." It is passed right through to the joint and is used as a lever to hold the head of the humerus away from the glenoid cavity thus giving a clear view of the anterior margin and room to work in.

MacLaughlin (1944) describes a trans-acromial approach to lesions of the shoulder joint and claims that almost all except the most anterior and inferior portions of the joint can be examined.

Our experience with this approach in four cases of supra spinatus lesions and one case of arthrodesis leads us to believe that it is unsatisfactory for Bankhart's procedure as a good exposure of the area of the lesion, i.e., the anterior margin of the glenoid cannot be obtained.

*Other operative procedures:—*

1. On bony structures :
  - (a) deepening the glenoid from behind (Hildebrand)
  - (b) bone graft at the margin of the glenoid (Eden, Speed).
2. On the capsule: Anterior capsulography (Ricord), Henderson, Albee, MacAusland).
3. (a) Muscle transference or lengthening (Clairmont, Ryerson, Magnusson, McLaughlin).
- (b) Operation on subscapularis.

(c) Hoffmann's cutting the latissimus dorsi.

(d) Finsterer and Mandl's keeping a band of coraco-brachialis and biceps anteriorly.

4. Suspension operations (Henderson).
5. Biceps tendon operation (Nicola).
6. Combinations (Hobart).
7. Arthrodesis of shoulder.

Nicola (1929) got his inspiration from the anatomy department. In an articulated skeleton, the humerus is held in place by a metal pin passed through the head and attached to the upper angle of the glenoid fossa. In the dog the long head of the biceps runs through the head of the humerus. Nicola describes the technique thus: "a hole is made through the head of the humerus. This begins in the bicipital groove about one inch distal to the lesser tuberosity. It comes out on the articular head of the humerus,  $\frac{1}{2}$  to  $\frac{3}{4}$  inch from the edge of the articular cartilage. If it comes out less than half an inch distant from the articular cartilage, there is a chance of recurrence of dislocation. The synovial membrane surrounding the tendon should be removed as a routine, to ensure fixation of the tendon to the head of the humerus. The hole should not be too large."

The Nicola operation requires the capsule to be laid open wide, the transverse humeral ligament to be cut and the long head of the biceps to be displaced from its anatomical and physiological relationships. There is marked trauma to the articular surface of the humerus. As has already been mentioned, the long head of the biceps is an important steadying factor and operations such as Nicola's which interfere with the integrity of the tendon are not to be advocated. In each case of recurrence following a Nicola operation the tendon had torn loose from its attachment where it entered the head (Stack). When all these cases were re-operated on, it was found that there was no tendon remaining except a little ball at the upper edge of the glenoid in some cases. In others there was no trace of the tendon of the long head of the biceps

either attached to the glenoid or to the head. In two cases a gutter was found in the bone, exposing the channel through which the tendon traversed the head of the humerus, and containing nothing except a few strands of fibrous tissue. Keruwein in a study of tendon transplantation in dogs found that the tendon did not exist as such but degenerated into a few strands of fibrous tissue.

In one of our cases (Nicolas) there was recurrence four weeks after operation.

Bone transplants were used by Oudard (1924), Eden (1917) and Speed. The idea of an "anterior block" occurred to Speed when the structures were exposed during an operation for Radical Mastectomy and he treated his next case of Recurrent Dislocation by producing a bony bridge between the scapula and the humerus without opening the capsule.

*Eden's operations.*—Eden implanted a bone graft from the tibia on the bared anterior surface of the neck of the scapula overhanging the joint so as to prevent luxation.

Kellog Speed and Phemister use a bone peg taken from the tibia and driven into the antero-inferior border of the glenoid cavity leaving it projecting far enough to check luxation.

Oudard lengthened the coracoid process by dividing it across and interposing between the cut surfaces a graft from the tibia 4 c.m. long. Subsequently he split the coracoid and lengthened it by sliding down one half of the attachment of the Biceps and coraco-brachialis.

Ricordo and Fimiochietto use a coraco-glenoid bony bridge.

Dr. Sever of Boston says, "although plaiting or constricting operations on the capsule have been apparently successful in a number of cases—, yet the success was due not to any contraction of the capsule, but to the necessary interference with the muscles around the joint and in particular to the division and subsequent suture of the tendon of the subscapularis near its

insertion — an important part of Turner Thomas' operation of capsulorrhaphy. Other operators have divided part of the pectoralis major in order to enlarge the field of inspection."

Muscle sling operations such as Clairmont's came into vogue on the suggestion that most of the resistance of the shoulder against dislocation lay in the muscles and not in the ligaments and bone. Rich (1917) used the coraco-brachialis and biceps because he noticed that the capsule of the joint in these patients was not always lax and could not be plicated. He felt that the glenoid edge or the tendon of the supraspinatus, the subscapularis or the teres major were often torn and that any or all of these factors lead to recurrence.

Oudard (1924) stresses the importance of the subscapularis muscle in the retention of the humeral head. He sections and then overlaps the subscapularis tendon which thus shortened and reinforced, maintains its proper action. Tavernier while supporting Oudard's views, prefers the anterior bony block. According to Tavernier, no other procedure including Bankhart's operation and Henderson's tenoplasty is good.

The principle of tenosuspension is as follows. In anterior dislocation, the head of the humerus must go downward and forwards. If the downward extension can be prevented, the dislocation will not occur for there is sufficient muscular protection in the supero-anterior part of the joint to prevent the head from slipping out. Joseph used fascia lata and Henderson used peroneus longus tendon passed through holes bored in the head of the humerus and the clavicle and acromion process.

Young's operation consists in the lengthening of the tendons of the pectoralis major and latissimus dorsi.

It is interesting to review the experiences of various writers with the different types of operations:

1. *Tenosuspension*: Henderson in 1926 reported 30 cases in 5 years (20 males and 10 females) including 4 epileptics. He seems to have given

up this operation in favour of others but has since 1935 returned to the original tenosuspension operation. Since then he has reported 27 cases with 3 recurrences. In his latest report in 1944, he gives 50 successful results in 55 operations (11 females and 40 males) 10 patients were under 21 years of age and 30 were between 20 and 40. The youngest of the series was 16 and the oldest was 50.

2. *Nicola* reported 132 cases with 8 recurrences. The Nicola operation has been performed in a number of instances by various surgeons; thus Korter did 3 cases with no recurrence, Willard 10 cases, Albee 33 with 1 recurrence, Speed 15 and so on. Codman however writes "all the cases recurred. I do not advise operation but advise development of the internal rotators. From what I hear the Nicola operation is not the last word."
3. *Muscle sling operations*. Clairmont's operation. Clairmont had 14 recurrences in 43 cases and Anderson reported 4 failures out of 8. Ryerson did 10 cases, presumably successful.
4. *Bony block*. Tavernier (1930) reported 37 cases (25 males and 12 females aged between 25 and 40) with no recurrence. In the original operation there was trouble with sinuses and sequestra. Speed (1930) reported 7 cases. No relapses are recorded even after 7 years; there was some limitation of extension and obstruction in some cases and in a few pain; this operation is almost unknown outside France.
5. *Capsulorrhaphy*: Thomas (1930) reported 12 successes in 18 cases. Henderson between 1926 and 1935 had 19 recurrences in 60 cases and gave up the operation. Trethowen draws attention to the difficulty of

plicating the capsule on account of the general distension and the present writer has always noticed that the capsule is already tight and cannot be plicated.

6. *Bankhart's operation*: Bankhart had no recurrence in his 27 cases and Watson Jones reported 30 successful operations. Moroney (1945) in a report of 27 cases has abandoned the Nicola operation following one early relapse and has since adopted the Bankhart procedure in his last 11 cases.
7. Heygroves while admitting the pathology as described by Bankhart pleads for a simple operation of suspension by means of a fascial sling through the quadrilateral space and tied above the coraco-acromio clavicular arch.
8. In the experience of the writers the first two cases were treated by the Nicola procedure and one recurred 4 weeks after operation. Of the 12 subsequent "Bankhart cases" none have so far recurred. The first case, a cook, done in August 1943 had had 20 dislocations previously but has had none since the day of operation.

Watson Jones states that any operation on the shoulder joint can prevent recurrence of dislocation so long as it is "sufficiently traumatic and sufficiently bloody." He contends that technique is unimportant so long as enough scar tissue is produced in front of the joint to limit backward extension and external rotation so that the humerus cannot face the position required for the head to slide over the injured glenoid margin. This statement is incorrect. The Bankhart procedure (very well described by Watson Jones himself in his "Fractures and joint injuries"—1944) is anything but a bloody operation and if it depended on trauma only for its efficiency, there would be a very large percentage of failures because the trauma is slight. All the patients operated on by me have been X-rayed a month after operation, and the



coracoid process has been found well united in good position in every case. The patients have been followed up and show no loss of backward extension or lateral rotation and this inspite of having the arm bound in internal rotation for three weeks. They are all employed as formerly (soldier, cook, electrician, peon, etc.) and in all the cases except three the right shoulder was the one affected.

### SUMMARY AND CONCLUSION

1. A study is made of 99 cases of Recurrent dislocations of the shoulder, with reference to age and sex incidence, body build, type of injury and family history.

2. The type of injury in recurrent cases is discussed with special reference to Bankhart's theory.

3. The incidence in epileptics is noted and a point made out of recurrences occurring during the chronic spasms of tetanus. The pathology as noted in 12 operated cases is described.

4. The technical difficulties experienced in 12 cases in which the Bankhart procedure was adopted are noted and a discussion made of the comparative merits of various operations, with reference to after affects.

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### APPENDIX OF CASES

1. Subramaniam, cook, aged 30, right, operated on in September 1943.

2. Convict, No. The Penitentiary, September 1943.

3. Shanmugham, aged 25 years, right, 16-12-44. Capsule torn anteriorly in two places.

4. Kandaswami, 20 years, left, 10-4-44.

5. Kulla Naicker, 27 years, right, 6-11-44.

6. Selvaraj (Tailor), 22 years, right, 3-1-45.

7. Sivaram, 23 years, left, 5-3-45.

8. Sampath, 24 years, left, 15-5-45.

9. Alagiriswami, 22 years, right, 29-6-45. Epileptic, seen recently all movements good.

10. Rozario, 23 years, right, 10-7-45. Glenoid labrum torn in two places. Margin repaired. Subscapularis thick. Cavity in front of neck of scapula.

11. Abdul Hamid, 21 years, right, 24-9-45.

12. Singaram, 25 years, right, 17-10-45.

All males, all between 20-30 years. 3 left and 9 right. All are under observation and are being followed up.

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## PRIMARY DIVERTICULITIS OF THE CAECUM

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Primary diverticulitis of the Caecum seems to be a very rare condition. Bennett-Jones has reported 3 cases and was able to find 17 cases in the literature. Edward Schnug (of Cincinnati) was able to record six of his own cases and 31 other cases. He has made a careful study of the subject. The condition may not be so rare as it appears to be because it is likely that cases which have perforated and formed abscesses in the right Iliac fossa are always regarded as the result of perforation of the appendix. Wagstaff in 1926 reported a case of acute primary Typhlitis. He found acute inflammation of the posterior part of the Caecum which had become almost gangrenous without any inflammation of the appendix. It is very probable that the condition was due to the perforation of a diverticulum.

Acute diverticulitis in this situation is difficult to distinguish from acute appendicitis and one should be prepared for this

possibility while opening the abdomen for the latter condition.

Usually in acute diverticulitis, the adjacent walls of the Caecum are also affected so that local excision may not be possible. "The technical difficulty together with the definite tendency of the lesion to drain into the bowel and subside suggests that surgical removal by radical procedure or local excision is definitely contra-indicated in most cases. Except in cases in which an abscess has developed and drainage is indicated, the abdomen should be closed without appendectomy and without drainage and chemo-therapy should be used" (Edward Schnug). According to the majority of Surgeons, however, excision of the diverticulum with closure at the neck is the method of choice and when the inflammation extends to the Caecum, local excision of the Caecum surrounding the diverticulum is suggested.

In the case reported below, the wall of the Caecum surrounding the diverticulum was quite normal and so local excision was not difficult.

*Case Report.*—Dr. N. P. Male—age 37, was admitted for attacks of lower abdominal pain with vomiting and rise of temperature since 1942. The first attack was thought to be due to acute appendicitis. Through a McBurny incision, the appendix was removed. The appendix was said to have been slightly inflamed. Six months after the operation, he began to get similar attacks again. Each attack used to last for a fortnight and of late the attacks have been coming on more frequently. The Physicians whom he consulted subsequently attributed the attacks to adhesions and advised against operation.

*On examination.*—Caecum was found palpable and tender; no other abnormality; Heart and Lungs—normal; Urine—Sugar nil; Albumen. nil; no casts or cells.

*X-Ray.*—Plain skiagram showed no evidence of renal or gall stones.

*Barium meal pictures.*—Normal stomach with large duodenal bulb. Caecum shows restricted mobility and there is some delay in the terminal ileum, perhaps due to adhesions and tendency for spasms to supervene producing delay in the passage of the meal.

In view of the persistence of these attacks which suggested the existence of some focus of recurring inflammation it was decided to explore the abdomen.

*Operation notes by Dr. C. P. V. Menon.*—Spinal anaesthesia—Right paramedian inci-

sion. The Omentum was adherent in the Right Iliac fossa. This was released. There were some adhesions near the termination of the Ileum. These were also divided. In the Caecum, about 2" distal to the ileocaecal valve, was a diverticulum, the size of a marble containing a hard concretion. There was also a Meckel's diverticulum in the usual situation. No other pathological lesion was found. The two diverticula were excised and the abdomen closed in layers. The patient had an uneventful recovery and was discharged from the Clinic in a fortnight.

It is highly probable that the 1st attack was due to acute diverticulitis and the condition might have been missed due to the inadequate exposure of the McBurny incision.

### SUMMARY

A case of Primary diverticulitis of the Caecum which was mistaken for acute appendicitis and treated as such is reported.

It is suggested that the condition was missed at the first operation on account of the inadequate exposure obtained with the McBurny approach.

I wish to thank Lt.-Col. K. G. Pandalai and Dr. C. P. V. Menon for permitting me to report this case.

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## HYDRONEPHROSIS IN ONE HALF OF A HORSE-SHOE KIDNEY

by C. P. V. MENON, General Hospital, Madras.

Pathological conditions affecting fused Kidneys are of considerable importance to the Clinician apart altogether from their embryological interest as the non-recognition of such an anomaly may result in the inadvertent removal of the whole fused renal mass with a fatal result. A few instances of such a major calamity have been recorded in the literature but many more must have gone unrecorded. It has been generally held that the condition, in itself, does not call for Surgical treatment. Foly and Wilmer (1938) have, however, indicated the possibility of a Surgical attack on fused kidneys of the unilateral and the horse shoe type for relief of pain and the arrest of hydronephrotic changes. Donohue (1932) reported six cases of operative division of the Horse-shoe Kidney and previous to that there seems to have been only about a dozen cases reported in the literature. Foly had since employed "symphysiotomy with nephropexy" in 5 cases of Horse-shoe Kidney and one case of Unilateral fused kidney. From a collective review and from their own experience with 5 cases of Horse-shoe Kidney and one of unilateral fused kidney, Foly and Wilmer express their belief "that the pelvic dilatation occurring with these anomalies and the pain accompanying them are capable of correction and relief by a well-conceived Surgical procedure which is feasible unless prevented by the vascular arrangement or the form or extent of fusion."

The Horse-shoe Kidney while being subject to all the pathological conditions affecting normal Kidneys, is peculiarly liable to hydronephrotic changes—in fact a mild degree of dilatation of the pelvis is always present. This is due to the abnormal position of the pelvis—ventrally situated with one or more Calyces directed mesially—and the abnormalities of vascular arrangement. The mesial direction of the calyces and the alteration of the axes of the Kidneys which

point downwards and medially instead of downwards and laterally is the result of interference with the normal ascent and rotation of the Kidneys and it is on these abnormalities that the pyelographic recognition of the condition depends. In the case under report, dilatation of the pelvis had progressed considerably more on one side and gone on to the point of complete destruction of renal function. The patient presented himself for what was to all intents and purposes a unilateral hydronephrosis with, however, a few unusual features—the cystic tumour being situated rather too low and too much to the front. This abnormal situation and the pyelographic appearances on the other side enabled a pre-operative diagnosis of the abnormality to be made and prevented the inadvertent removal of the whole renal mass—a calamity which could conceivably have occurred otherwise.

*Case Report.*—Patient, Adikesavalu, Hindu, male, aged 18 years, occupation—coolly, was admitted into the General Hospital, Madras, on 3-6-'43, for a swelling of the lower abdomen. He had noticed a small swelling ever since he can remember and it has been gradually increasing in size; for the last 10 days it has become painful. He did not complain of any other symptom; micturition has been normal. On examination, the patient, a well-nourished boy of 18 years presented a globular swelling in the lower abdomen about 10" in diameter occupying the hypogastric, umbilical and left lumbar regions. The swelling was firm and smooth with well-defined outline. It was slightly movable from side to side and upwards and downwards, but did not move with respiration. It was dull on percussion throughout there being no band of resonance in front and a fluid thrill could be elicited. A plain Roentgenogram showed a diffuse opacity in that region and no foreign shadows. A Barium enema (Fig. 1) showed the des-

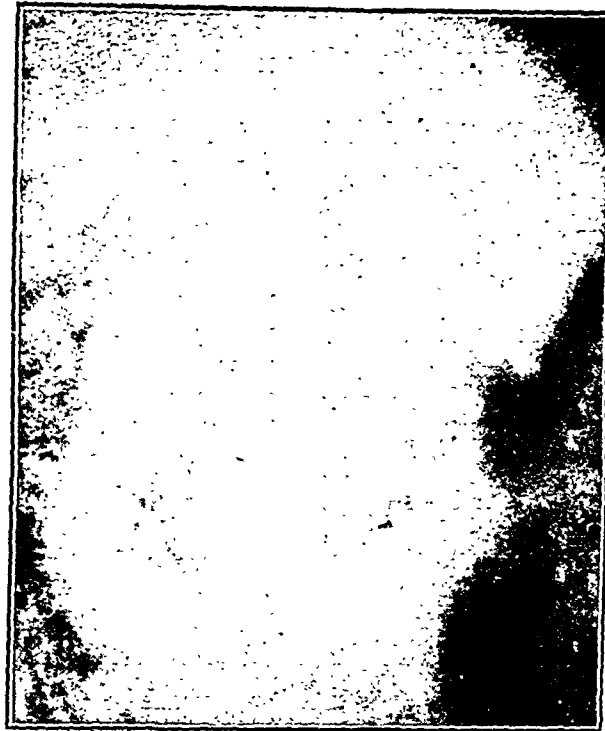


Fig. 1

Ba enema.—Shows the displacement of the colon and indicates the size of the Cystic swelling.



Fig. 2.

Excretion Pyelogram.—Shows complete absence of excretion on the left side and the reversed position of the pelvis on the right side. Calyces directed medially and the pelvis laterally situated.



Fig 3.

Photographs of specimen.—Shows the posterior view in which the lobulated, elongated outline of the left limit of the horse-shoe can be made out. The large dilated pelvis is in-front with the probe in the ureter.

cending and Iliac colon pushed over to well across the middle line. This accounted for the absence of a band of resonance in front. The urine showed nothing abnormal except a few pus cells, but no organisms were grown in culture. I. V. Pyelogram



Fig. 4.

Excretion Pyelogram after operation.—The slightly increased dilatation as compared with Fig. 2 is well seen.

(Fig. 2) showed no excretion on the left side. On the right side, the pelvis was lying laterally with calyces directed medially. There was early hydronephrosis. The blood Urea was normal. Cystoscopy was done on 7-6-'43 and a catheter passed into the right ureter. Urine was drawn from this and showed on analysis a percentage of 1.09% of urea. On the left side the catheter could be passed for about half an inch at which point it seemed to be arrested. A retrograde pyelogram was not done on the right side as one did not like to take any liberties with the only functioning Kidney.

From the X-Ray appearances, a diagnosis of a horse-shoe kidney was more or less confidently made. Four days later, he was operated on under General anaesthesia. The left Kidney was exposed by a loin incision. The tumour was found to be a large hydronephrosis. To facilitate removal, it was tapped, 80 oz. of brownish fluid being drained. On dissecting up the sac, its connection with the other side was made out, and looked like kidney tissue about an inch broad. This was crushed divided and over sewn. The ureter was narrow and

was divided. The vascular pedicle, situated rather lower down than usual, was clamped and divided close to the Kidney. The fluid from the hydronephrotic sac contained 4.1 mgms. % of urea. His convalescence gave no anxiety.

An I. V. Pyelogram (Fig. 4) taken a month after operation showed a little more dilatation than in the previous picture. A nephropexy on the line suggested by Foley might have prevented this, but the author was at the time unaware of this procedure. The patient has not reported since and is presumably well.

## SUMMARY

A case of Hydronephrosis in one half of a Horse-shoe Kidney is reported and a reference to available literature made.

A pre-operative diagnosis could be made from pyelographic appearances and thus inadvertent removal of the whole mass was avoided.

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## FIRST RIB SYNDROME

by DR. S. C. MISRA, M.B.B.S., L.R.C.P., F.R.C.S.,  
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AND

DR. M. L. SHARMA, M.Sc., M.B.B.S.,  
*Demonstrator of Surgery, Medical College, Agra.*

## INTRODUCTION

The possible occurrence of ribs in parts other than the thoracic region is explained by the existence of the myosepta and other skeletogenous structures in all regions. Primitively there is a pair of ribs for every vertebra from the axis to the sacrum. Some fishes have even two pairs. Ancestors of modern man had more than 12 pairs. During the course of evolution ribs have been reduced in number from both sides (cervical as well as lumbar). In the higher vertebrates they are confined to the thoracic region only. That reduction is going on in the number of pairs of ribs is borne by the not infrequent occurrence of anomalies at the cervical and lumbar ends. Persistent cervical ribs are more frequently incomplete and fail of direct sternal attachment. The first pair of thoracic ribs may sometimes be incomplete (Pilling, quoted by Walters, 1930). Bifurcation of ribs some times occurs at their vertebral ends (Arey, 1943). A

cervical rib may fuse with the costal elements of the first dorsal rib and this gives rise to a bicipital rib (Wood Jones).

The first dorsal rib has been seen to end like an ordinary second rib. Very rarely the first true thoracic rib is incomplete (Huber, 1930) being continued in ligament to the sternum, joining the costal process of the second or ending free. A bicipital rib may occur also by fusion of the first thoracic with the second beyond the tubercles. Rudimentary first rib is often mistaken for cervical rib (Frazer, 1940). The first rib occasionally shows reduction in extent, being short and slender, its costal cartilage being likewise reduced and replaced in part by fibrous tissue connected with the second costal cartilage. Ossification of the first cartilage affecting the surface and resulting in a bony enveloping mantle is frequently encountered (Huber, 1930).

The vertebral end of the first thoracic rib may be joined by a cervical rib, or by the



Fig. 1.

Preoperative X-ray showing the deformed first rib with false joint and its fusion with the second



Fig. 2.

Skiagram taken after operation showing most of the rib removed with the exception of a small portion at the back.





vertebral end of the second thoracic rib, in which cases a bicipital rib occurs. The anterior extremity of the rib may be bifurcated. The adjacent ribs may be connected by small plates of bone (Frazer, 1937).

The comparative aspects of the first dorsal rib are, too, not less interesting. Confining to the mammals only, in *Notoryctes* (which has fourteen pairs in all) the first rib is very stout and is abruptly bent on itself to join the sternum. It has no distinct sternal portion. In the *Armadillos* it is remarkably broad and flat and is not divisible into vertebral and sternal portions. In the *Cetacea* it is the only rib attached to the sternum.

Principal factors involved in the production of anomalies of the skeletal system are faulty histogenesis, developmental arrest and over development.

### HISTORICAL

As far back as the 19th century Leboucq (quoted by Walters, 1930) mentioned in words as well as in drawing about the occurrence of abnormal ribs on the 7th cervical vertebra and the reduction of the first rib. Theodore Thompson (1908) pointed out that when a bony prominence can be felt with ease the Brachial plexus is free from pressure of the abnormal rib. A few years later Sir Percy Sargent observed that the symptoms might be present on the side with smaller abnormal rib and not on the side with a bigger rib. One of the most important contributions to our knowledge of these cases came from F. Wood Jones who in 1912 pointed out that anomalies in arrangement of limb plexuses are primary and not secondary to anomalies in disposition of ribs and vertebral elements. That symptoms might be produced by the abnormal first dorsal rib was described by L. Rogers (1937), W. McK. Craig and P. A. Knepper (1937) reported six cases from the Mayo clinic.

### CASE REPORT

Har Bhagwan, a Hindu male student, aged 11 years, from Dholpur was admitted to the surgical wards on 4-8-'45. He com-

plained of swelling over the right collar bone, pain at the above site as well as in the axilla and involuntary movements of the fingers of the left hand when the patient attempted to write with his right hand. He also complained of slight weakness of the right arm. The duration of trouble was four years. He did not give any history of pain down the arm.

On examination there was a swelling just above the lateral third of the right clavicle  $1\frac{1}{2}'' \times 2''$  with diffuse and irregular margins. On palpation it was bony hard, the hardness continuing with the vertebral column behind. It was tender. The pulsations of the subclavian artery were visible.

*Examination of the right upper limb.*—There was no wasting of muscles, no drooping of the shoulder, no colour changes in the hands, fingers or nails (tested both in dependent position as well as by raising the arm.) On palpation there was no hyperaesthesia, anaesthesia or paraesthesia. Warmth was normal. Radial pulse on right side was 90 per minute and on left side 86 per minute. There was no difference in the rate, rhythm, volume, or tension of the pulse in the raised and hanging down positions of the limb. The grip of the hand was slightly weaker on the affected side.

*X-ray report.*—(Preoperative).

*Lateral view.*—First rib on the right side deformed. First and second ribs fused anteriorly. First rib has a false joint.

*Post-operative.*—A.P.

Read with the previous report. Part of the 1st rib resected. Fusion of the anterior ends of the 1st and 2nd ribs confirmed.

The X-ray plates further show rudimentary cervical rib on the right side.

*Operation notes.*—The patient was operated on under Chloroform anaesthesia by Prof. S. C. Misra, F.R.C.S. An incision 6'' long was made along the crease of the neck, parallel to and 1'' above the clavicle. The deep fascia was divided till the borders of the Trapezius and the Sternomastoid were exposed. The Sternomastoid was partially divided. The lateral margin of the Scalenus anterior was then identified and it was par-

tially divided. The phrenic nerve was pushed medially. The lateral cord of the Brachial Plexus was seen emerging from under the lateral margin of the Scalenus Anterior. The subclavian artery was also identified.

The transverse scapular vessels which obstructed the way were clamped and ligatured. It was now seen that the artery and the cord were passing in between the knob like eminence of the first rib and the clavicle. It was also felt that the Scalenus anterior was contributing its share in narrowing the space.

Anterior Scaleneotomy was performed and the rib was now plainly felt and seen. The periosteum over it was incised. The joint (costo-chondral junction) was seen lying behind the structures. The first rib was carefully cut at the cartilaginous point and as much of the rib as possible was removed. The deep fascia was then apposed and the skin sutured.

*Post-operative care.*—The patient was kept in recumbant position. Breathing exercises and exercise of the right upper limb were given two-hourly. He was given exercises for the neck muscles. He was asked to practise writing with his right hand and it was observed that the involuntary movements of the left hand had disappeared. He made an uneventful recovery.

#### IMPORTANT POINTS IN THE CASE

The case is peculiar in the following respects:—

1. The occurrence of an abnormal first rib producing symptoms at such an early age. The position of this abnormal rib as compared to the corresponding rib on the opposite side. The peculiar synchondrosis in the rib.
2. Marked prominence of the cartilaginous joint of the two component parts.
3. The occurrence of involuntary movements of the fingers in the left hand.
4. The first rib is fused with the second at its anterior end.

#### ACKNOWLEDGEMENT

We are most grateful to Major General H. C. Buckley, Superintendent, Thomason Hospital, for his kind permission to report this case.

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## CONGENITAL CYST BRAIN

by DR. D. GOVINDA REDDY, M.D. and DR. C. MOHAN RANGAM, M.D.,

Department of Pathology, Medical College, Madras.

The patient a male of 56 years was admitted moribund and comatose with dilated pupils, rapid pulse and absent plantar reflexes. The urine showed no sugar and no acetone but a trace of albumen.

During the post-mortem examination, nothing grossly abnormal was found in any of the viscera. The surface vessels of the brain were congested and Parieto-occipital region felt cystic; a medial sagittal section revealed an orange sized cyst in the left parieto-occipital region with an opaque wall and clear contents.

The cyst during its growth appeared to have filled the lateral ventricle and distended it stimulating a unilateral internal hydrocephalus. Scrapings from the wall of the cyst did not show any hooklets. Dissection after fixation showed the pedicle of the cyst adherent to the choroid plexus. Histologically the wall of the cyst was formed by consecutive strands of fibrous tissue lined by flattened endothelium. It is possible that the cyst was congenital having its origin from the choroid, since there was no neoplasia. Congenital cysts of the choroid reaching this dimension are very rare.



Fig. 1.  
Cyst of the brain in the left  
parieto-occipital region.

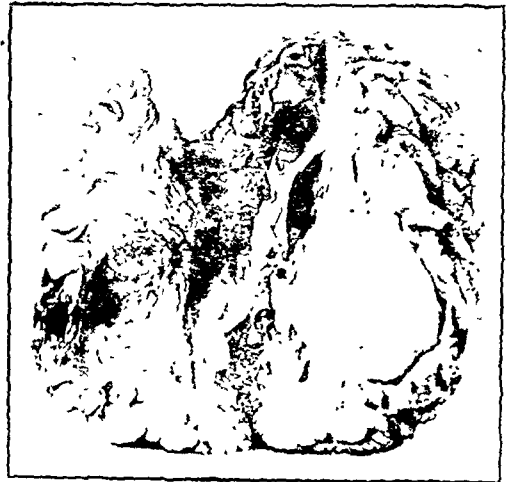


Fig. 2.  
The cyst is found filling the left ventricle  
with thinning of the cortex.

## ADENOMA OF PITUITARY

by DR. D. GOVINDA REDDY, M.D. and DR. C. MOHAN RANGAM, M.D.,  
*Department of Pathology, Medical College, Madras.*

The patient was a female of 25 years admitted for headache and blindness of 2½ years duration and progressive loss of vision. The pupils were regular, dilated and reacting to light and the patient was mentally deficient. A decompression operation was done when the brain was seen to be oedematous and to pulsate feebly. During the autopsy examination no evidence of pituitary dysfunction or hyperfunction could be gathered. There were a few adhesions in the left pleural cavity and both lungs showed basal congestion. On removing the skull cap, the brain matter was seen forcing itself out through the dura in the

fronto temporal region. The brain was oedematous and the C.S.F. increased in amount. The clinoid processes had to be chipped to expose a small egg sized hard nodular tumour in the region of the optic chiasma. A median sagittal section of the brain confirmed that the tumour had its origin in the Pituitary and was reddish brown from haemorrhage. Histologically the tumour was a chromophobe adenoma of Pituitary. Special methods of staining such as Mann's and modified Mallory's Aniline blue technique failed to show either acidophilic or basophilic granules.



Fig. 1.  
Median sagittal section of the brain showing  
adenoma of Pituitary gland.

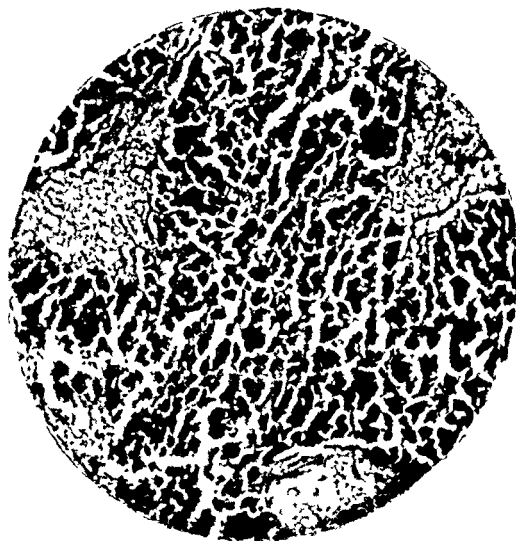


Fig. 2.  
Photomicrograph showing chromophobe  
adenoma of Pituitary.

# A CASE OF CONGENITAL UNILATERAL HYDRONEPHROTIC ECTOPIC KIDNEY WITH CALCULI

by DR. S. P. SRIVASTAVA, M.S., F.R.C.S. (Eng.), Medical College, Agra.

"R"—A patient aged 20, Hindu, Male, vegetarian was admitted into Thomason Hospital, Agra, on 3-8-'45, with the following complaints:—

Pain in the left Iliac fossa—1 year.

*Past History.*—Nothing of clinical importance.

*Present History.*—Patient stated that he had been having a mild pain in the left Iliac fossa for the last one year. The pain was not colicky in nature and did not have a tendency to radiate in any direction. He never complained of any pain or difficulty in micturition.

*Examination—Local.*—On palpating the left Iliac Fossa, two stony hard tender swellings each about  $\frac{1}{2}$ " by  $\frac{1}{2}$ " were found. They were fixed to the surrounding structures and were Intra-abdominal. The hard Lumps appeared to be calcified glands.

*Investigation.*—

(a) *Urine examination*—Normal with the exception of few pus cells only.

(b) *Blood Urea*—61 mgms. per cent.

(c) *Plain X-ray abdomen*—No radio-opaque shadow in the kidney or ureteric regions. Two rounded—radio-opaque shadows in the region of upper part of left sacro-Iliac joint.

(d) *Excretion Pyelography after Intravenous injection of Uropac*—Left kidney Ectopic and shows evidence of hydronephrosis and presence of calculi. No excretion by Right Kidney. The shadow in the left kidney too was faint.

The left kidney was situated in the left Iliac fossa.

(e) *Total and differential W. B. C. count*—Total white cells—8,450 cmm.

Poly—64%.

Lymphocytes—32%.

Monocytes—4%.

*Treatment.*—Operation—

Anaesthesia—Spinal percaïn 1: 1500.—  
14 c.c.

Pre-medication—Luminal 1 gr.  
Ephedrine  $\frac{1}{2}$  gr. by  
intramuscular injection.

A left Lumbo-Inguinal Incision about 8" long was made and the muscles were cut till the kidney was exposed in the left Iliac region. The upper pole of the kidney was palpated and found to be free. On palpating the kidney pelvis, a stone was felt and this was removed by opening the pelvis from the anterior side as the surface was devoid of blood vessels. Another stone was found on the medial side and was also removed. The ureter was slightly bigger than normal and was patent. No evidence of horse-shoe kidney could be found. The nick in the Pelvis was closed by plain cat gut. Perfect haemostasis was insured—Sulphanilamidē powder was put in the wound and skin closed after leaving a drainage tube.

Patient was given Intravenous saline 700 c.c. with 5% glucose by drip method during the period of operation.

—He was given two Cibazol tablets three times a day.

—I. V. Glucose 25% 100 c.c. was given morning and evening for two days.

—I. V. Saline 150 c.c.

—Inj. Solusepticine 10 c.c. 10% Intramuscularly for two days morning and evening.

*Progress Report.*—Stitches were removed on ninth day. Healing was primary. Pt. did not develop any Post-operative complication during the course of treatment and was discharged on 13-9-45 completely cured.

## DISCUSSION

This case is interesting from several points of view. The history of the case never gave any indication of the presence of any calculus in the Urinary Tract. Urinary symptoms were conspicuous by their absence. The stony hard lumps being stones in the Pelvis could be felt per abdo-

of the right ureter. At operation one the stones was removed from a lower caly which was directed medially and backwa showing either the extension of the kidn mass of the lower pole towards the midd line in the pelvic cavity or abnormal pos tion of the calyx in the left ectopic kidney.



Fig. 1.

Plain X-ray showing dumbbell shaped radio-opaque shadow over the left sacro-iliac joint.

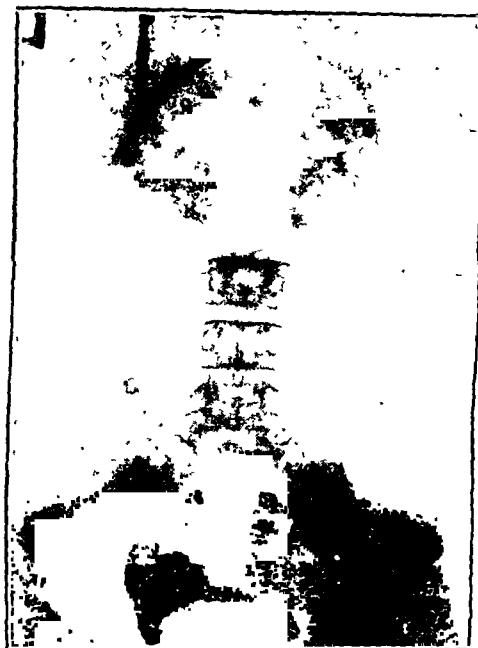


Fig. 2.

Pyelogram after injection of uropac showing faint dilated shadow of the pelvis of left ectopic kidney.

men, because the patient had thin abdominal walls and the pelvis of the kidney was situated anteriorly to the kidney swelling. The latter was not at all palpable. The patient had a high blood urea and the shadow of the dye in the pyelogram was faint showing degeneration of the only existing kidney. This made the operation imperative. The stones could be removed without difficulty from the pelvis by incising its anterior wall which had no blood vessels in front of it, the blood supply of the kidney being situated posterior to the Pelvis and arising from the left Iliac vessels in such cases. The lower pole of the kidney could not be defined properly, as it extended into the Pelvic cavity.

The X-ray showed the left ureter bigger than the normal size and complete absence

The single left ureteral shadow and the site of kidney indicated that it was either a case of single Left ectopic kidney with calculi and slight hydronephrosis, or unilateral fusion of left ectopic kidney with both ureters opening on the left side.

Cystoscopy and injection of Indigo-carmin could have cleared the presence of one or two ureteral openings but it could not be done, but usually even if there are two ureters on one side, the opening in the bladder is single.

In my opinion the case appeared to be one of left ectopic kidney with abnormal situation of calyces and stone formation as is probable in such cases. It would be interesting to watch the fall in blood urea after some time as the kidney function improves.

## PSYCHO-SURGERY\*

by DR. B. N. BALAKRISHNA RAO

Mr. President, Ladies and Gentlemen,

I thank you for the opportunity given to me to place before you a subject which perhaps is an innovation in surgery—a method of treatment of mental disorders by surgical means. Historically speaking, it certainly is not new. The operative treatment of “lunacy” as then known and understood was known and practised from prehistoric times. It is worthy of remark that in the glimmerings of surgery, operations on the skull and brain were about the earliest. Mummies unearthed in Egypt and Peru show that the operation of opening the skull *i.e.*, trepanning, was not unknown to the people at the time. With sharpened flints and teeth of fish, they made a hole in the skull. Among hoary superstitions the one concerning itself with the belief in the “possession” of the human body and the mind by demons is perhaps the most interesting. For the relief from this “possession” the aid of the witch doctor, the equivalent of the modern surgeon, was not infrequently invoked and many prehistoric skulls testify to the successful performance of this formidable operation.

Thus the surgery of mental diseases has been in reality one of the oldest branches of surgery, if not the forerunner of other surgical procedures. Reasons for such a procedure might be considered incorrect from modern knowledge of the physiology of the brain; but nevertheless the aid of surgery certainly was sought for the relief if not cure of mental diseases.

The branch of neuro-surgery which I have in mind to-day is what is generally termed Psycho-surgery. Psycho-surgery consists in the surgical operation on the anatomically intact brain for the purpose of relieving abnormal mental symptoms. It

was first devised and named by Egaz Moniz, the distinguished Portuguese neurologist, essayist and diplomat, following the Third International Neurological Congress in 1935, at which time a remarkable symposium was offered on the function of the frontal lobes. Moniz published his monograph in 1936 detailing the results of his first twenty operations in mental patients.

Moniz had observed that individuals with organic lesions of the frontal regions of the brain showed varying degrees of emotional instability, lessened inhibition with the development of what might loosely be termed as an easy-going personality. He, therefore entertained the hypothesis that doubt, indecision, worry and anxiety were mediated through arcs in the frontal regions, and argued that if these pathways could be destroyed, the individual could then exist on a much more comfortable level. It might be remarked in passing that this is too naive a hypothesis, but that need not deter us from admiring his work.

Hebb and Penfield have investigated human behaviour after extensive bilateral removal of the frontal lobes. A case of traumatic injury had destroyed somewhat less than one-third of each frontal lobe, and left a scarred zone in each hemisphere, giving rise to continuing abnormal electrical potentials, and to recurring epileptic seizures. Although after operation a third, and possibly more of the total volume of each of the frontal lobe was lacking, there was a striking post-operative improvement in personality and intellectual capacity, with the same medication as before the operation. No clinical or psychometric evidence of deterioration was detected. It was concluded that removal of a third of both frontal lobes uncomplicated by pathological change in the rest of the brain need have no grossly deteriorating effect.

Moniz (1936) in discussing the theory which led him to propose prefrontal leuco-

\* A lecture delivered at the seventh annual meeting of the Association of Surgeons of India December 1945.



tomy, considers that, whereas in normal people the functional connections between the cortical cells are variable giving rise to innumerable different groupings, in certain mental disorders, some functional groupings more or less fixed and give rise to obsessions and delusions. Mental improvement may become possible by cutting the association fibres concerned in these persistent pathways.

Consideration of the physiology of the frontal lobes shows that the operation is based on sound principles. Injury to the frontal lobes results chiefly in alterations of behaviour, as is well exemplified in the American Crow-bar case. Behaviour changes have also been noted after the surgical removal of the frontal lobes in man and animals. Distractibility, lack of restraint and boastfulness have been reported by Brickner, and slowness, deliberate activity, perseverance and freedom from anxiety by Ackerly. Similar changes have been noticed in experimental animals. This work has shown that removal of frontal lobes in man and animals. Distractibility, lack of restraint and boastfulness have been reported by Brickner, and slowness, deliberate activity, perseverance and freedom from anxiety by Ackerly. Similar changes have been noticed in experimental animals. This work has shown that removal of frontal areas gives rise to some form of deficiency termed 'intellectual.'

With this experimental and clinical data as a background Moniz devised the operation of prefrontal leucotomy in mental disorders.

Moniz's original technique has been modified by numerous workers, notably by Lysterly (1938) and by Freeman and Watts. The operation essentially consists of severing the white matter arising from the cells of prefrontal cortex. This isolation of the prefrontal cortex is best attained by cutting the subcortical white matter as it lies in front of the anterior horn of the lateral ventricles. Moniz approached this area by trephine holes from the superior aspect of the skull, crushed the white matter with an

expanding loop of wire, and injected alcohol to make sure that most of the white matter had been interrupted. Freeman and Watts in 1939 modified this method by approaching the frontal lobe from the lateral aspect of the skull; the white matter being severed by a Killian's nasal elevator.

Lysterly using a lateral approach similar to that recommended by Freeman and Watts, turned down a flap of bone and exposed the brain: after introduction of a brain speculum, the white matter was severed under direct vision. This open method is fundamentally sound and is attractive to all those who hate a blind procedure, but it has the disadvantage of being a formidable operation. The Freeman and Watts' technique is simple and relatively safe. Our experience has indicated no serious disadvantages, and we do not feel justified in submitting our patients to the more severe and consequently more risky Lysterly technique.

The technique followed by us is practically similar to that recommended by Freeman and Watts. The preoperative preparation is similar to that of any surgical operation. If the patients are very apprehensive or violent, one capsule of sodium amytal is given overnight. The head is completely shaved in men and in women only that portion of the scalp which is anterior to the line joining the two external acoustic meatus over the vertex. The patient lies flat on the table, the head slightly raised on a pillow.

A trephine hole  $2\frac{1}{2}$  cms. behind the anterior orbital margin and  $5\frac{1}{2}$  cms. above the zygoma, is made. This measurement is preferable to the measurements given by workers in Europe and U.S.A., viz., 3 cms. and 5 cms. because of the frequency with which the middle meningeal artery is met with in the burr opening. To facilitate this measurement a localising plate is used. The incision runs along the course of the fibres of the Temporalis muscle and splits the fibres, and is entirely within the hair margin. The coronal suture is used as a guide for the burr hole, though in our experience

we have seldom been able to see it, so that, we have relied on the surface measurements alone.

The size of the trephine opening is variable, but our preference is to make a hole in the skull  $\frac{3}{8}$  inch in diameter with a burr using a Hudson or a Carr's brace. An avascular area of the dura is lifted with a dural hook and incised with a cataract knife, and the width of the brain measured with callipers. After the dural incision, a variable amount of cerebro-spinal fluid escapes, in some cases as much as three ounces.

The diameter of the brain is measured in order to estimate the thickness of the white matter. In a series of measurements it was found that the maximum width of the brain in our series was  $11\frac{1}{2}$  cms. and the minimum  $9\frac{1}{2}$  cms. with an average of  $10\frac{3}{4}$  cms. The thickness of the white matter was estimated after a series of measurements of the thickness of the white matter to the grey matter at the level of leucotomy was made in cadavers. It was found that the width of the white matter was equal to the sum total of the thickness of the grey matter. Therefore the instrument can be introduced through  $\frac{3}{8}$  of the width of the brain without damaging the grey matter on the mesial surface of the frontal lobe.

An avascular area of the dura is lifted with a hook and incised with a cataract knife, opening the subarachnoid space. The amount of cerebrospinal fluid escaping is variable, and sometimes as much as three ounces on each side, which is of no consequence. The white matter is now cut by introducing the leucotome to the desired depth in the direction of the opposite trephine opening.

Different varieties of leucotomes have been used. Moniz in his original method used a steel loop working like a nasal polypus snare. Freeman and Watts used an ordinary blunt Killian's nasal elevator after making sure by means of spinal needle that the track of the elevator would not intersect the anterior horn of the lateral ventricles. McGregor and Crumbie intro-

duced a leucotome which cuts cores of  $2\frac{1}{2}$  cms. diameter by a knee action screw. In our first twenty-five cases the Killian's nasal elevator was used, and later when the McGregor and Crumbie leucotome was received, it was used in a few cases. After using the McGregor and Crumbie leucotome in a few cases, in one case when the instrument was inside the brain, the mounting of the rotary blade slipped, and the instrument was withdrawn with the greatest difficulty after much damage to the brain. After this accident, a simplified leucotome was devised with the assistance of Dr. Chandrasekharan which combines the simplicity of the Killian's elevator and the advantage of the McGregor and Crumbie leucotome. This instrument was made locally in silver and has been in use with us and is eminently satisfactory.

The white matter is severed by moving the elevator through an arc of 60 degrees in a plane parallel to the coronal suture. The plane through which the white matter has now been cut is known as "the plane of critical section," as, cutting the white matter in front of this plane will not produce much improvement, while section posterior to this plane produces certain undesirable consequences, and in some cases dangerous to life. In this plane the white matter constituting the fronto-thalamic radiation is in a compact mass just anterior to the anterior horn of the lateral ventricle. This bundle of white matter appears to be the most important of the fibres to be sectioned. The instrument is withdrawn and the amount of haemorrhage from the brain is usually very small and is controlled by warm saline irrigation. The dura is not sutured, and the wound is closed in layers without drainage. A similar procedure is adopted on the opposite side.

While the white matter is being severed certain changes are observed in the patient. American observers operating under local anaesthesia have observed a sudden release of psychic tension on completion of section of the white matter, which the patient can describe well. We have no experience of

this, as all our cases have been operated on under chloroform narcosis. Certain circulatory and respiratory changes have been observed when the white matter is cut. The respiration which is regular suddenly becomes irregular both in rhythm and depth. Short gasps are followed by long sighing type of breathing. Occasionally the respiration becomes shallow and a temporary period of apnoea has supervened. This is only for a short duration and respiration rapidly regains its rhythm and regularity. Sectioning of the opposite frontal white matter produces similar but less marked disturbances.

Simultaneously with the respiratory change, the pulse becomes irregular and sometimes thready and imperceptible. In no case in our series has the heart stopped, and it rapidly recovers after the completion of the section of white matter. It suggests to us that these changes are the result of the sudden interruption of some controlling influence of the prefrontal cortex on the respiratory centre, throwing the latter suddenly 'out of gear'; the cardiovascular irregularity being secondary to the respiratory disturbance.

No special post-operative care is necessary. The patient is propped in bed after recovery from anaesthesia. If there is restlessness or severe headache which is sometimes complained of, morphia is given, and repeated if necessary. The post-operative period in our series of cases has been singularly free from symptoms. Retention of urine was seldom seen, and incontinence of urine was present in three cases lasting from one to six days. All recovered within a week. Irregular rise of temperature was noted in a few cases lasting up to a week, for which no definite cause could be found.

One extremely striking feature during the post-operative period was the enormous appetite. A few complained of constant hunger inspite of full diet. During the period the patients were in hospital after operation, there was an increase in weight of all patients. This gain in weight could

not be ascribed to any special diet, rest or nursing, as such increase was not found in the post-Insulin or Cardiazol shock therapy period, though the post-shock and the post-operative periods were similar in diet, nursing, rest, etc. On the psychological side, in the immediate post-operative period, in a large number of cases, there is a profound change; violence has given place to quiet, bellicosity to modesty, the voices that used to whisper have been silenced, and the hallucinations have disappeared. The general demeanour is one of calm placidity. This change in the patient is progressive and maintained.

*Complications* after this operation are met with though not frequently. Some are transient and a few are persistent. Our experience has been more fortunate than the workers in Europe and the few complications that we have met with, like, headache, incontinence of urine, anisocoria have been transient.

*Haemorrhage* during the operation or soon after is the most serious, and has been the cause of a high proportion of fatal results. The source of haemorrhage is either from the main trunk of the anterior cerebral artery on the medial surface of the brain, due to the introduction of the leucotome to a greater depth than is correct or from one of its branches situated at the bottom of a sulcus of grey matter.

*Complications* met with by other workers are incontinence of urine lasting for one to three months, and sometimes permanently, anisocoria, Argyll-Robertson pupil, ptosis, nystagmus, etc. These are usually temporary and not of great moment. More severe, and producing mental deterioration, are, convulsions, restlessness and violence, tremors and fibrillary contractions of the platysma and the masseter muscles. They are of grave prognosis and often terminate fatally. Paralysis of varying intensity like hemiplegia, monoplegia, aphasia, sphincter disturbances associated with diarrhoea have been reported, and are to be viewed with concern when met with.

In spite of the formidable list of complications, an encouraging feature of this operation is the low mortality. Freeman had three deaths in thirty-one cases, Dax and Smith 2 in 50 cases. In our series of 75 cases up to November 1945, we had one death on the tenth day of the operation, as a result of an accident with the leucotome inside the brain. Excepting this, we have had no death attributable to the operation.

*Selection of cases for the operation.*—No definite conclusion have been arrived at as to the most suitable type of case for leucotomy. Cases are chosen only after every other known type of treatment has been given a thorough trial and failed, and should be reasonable operative risks. It is our impression that the chances of improvement after leucotomy depends on the patient's prepsychotic personality, family history, intellectual attainments, and the duration of the disorder.

The results of treatment of mental diseases are difficult to assess accurately as changes in the personality of the patient after the operation. In cases which show improvement the maturation of the personality may occur even after weeks or months. Initiative and capacity for constructive thinking increases with time.

Following the initial period of lethargy and disorientation after leucotomy which seldom lasts more than a week, a period of relaxation supervenes. Progress depends a good deal on the prepsychotic personality of the patient, the duration of the psychosis, and the stereotyped nature of the complaints or compulsions. Once the patient returns to his home in about four weeks after the operation, the newly emerging personality is developing and continues its evolution for a period of many months or even years.

A psychological survey of our first fifty cases operated on between 1942 and 1944 has been done by Mr. Vasudeva Rao, Psychologist at the Mental Hospital, Bangalore, and the following are portions from a paper sent for publication.

A patient is said to have 'recovered' when the leucotomy has helped him to regain the original place in the family setting and in the socio-religious sphere, his general health is satisfactory, and is able to follow his occupation.

A patient is said to have 'improved' when his general health is satisfactory, the symptoms for which the patient was admitted to the hospital have disappeared and no new ones have developed, but his adjustment to occupational and socio-religious life is not satisfactory.

The following table shows the effect of leucotomy in our first fifty cases, some of them performed over three years ago, but none of them less than a year ago.

#### RESULTS OF LEUCOTOMY IN THE FIRST FIFTY CASES

SEX	Recovered	Improved	Un-changed	Re-admitted	Remaining	Dead	Not traced	Total
MEN	8	9	5	4	6	2	1	35
WOMEN	3	6	2	1	2	1	...	15
TOTAL	11	15	7	5	8	3	1	50

The three deaths in this series were not primarily due to the operation but due to the operation but due to emotional oscillations of high intensity lasting for several days, occurring a considerable time after operation.

The following is a typical case history in the group 'recovered.'

Case No. 13.—Mrs. K., aged 25 years. Suffering from chronic maniac depressive state. Has two children, husband employed in government service. No trace of psychoneurosis in the family. Average intelligence, literate in two languages. Duration of disorder seven years.

At the time of admission she had :

- (1) Emotional depression and morbid preoccupation.
- (2) Refused to answer questions.
- (3) Indifferent to personal cleanliness.
- (4) Hostility towards husband and children.
- (5) Shuns the company of others.

Bilateral prefrontal leucotomy was performed on 26-3-43. Convalescence was uneventful and discharged from hospital two weeks later. In September 1945, the husband was seen and reports that the patient is exceedingly well. Eats and sleeps well. Is very happy at home with husband, children and others in the family. Went through a child birth quite normally. Is attending a ladies club, and does knitting and embroidery. Is well adjusted martially and socially after nearly seven years of illness.

The following is a typical case history in the group 'improved.'

Case No. 27.—Mrs. K. P., aged 45 years. Severe case of chronic depression. Has two children, the younger aged 25 years. Husband in very good social position. No evidence of neurotic or psychotic traits in the family. Duration of disorder 19 years.

At the time of admission she had :—

- (1) Poor general health.
- (2) Indifferent to personal cleanliness and filthy habits.
- (3) Indifferent to members of the family. Would not recognise her husband and children.
- (4) Incoherent and irrelevant murmuring utterances.
- (5) Seclusive.
- (6) Would eat only when fed.

Bilateral prefrontal leucotomy performed on 23-10-43. Was discharged from hospital after four weeks when she had shown considerable improvement in her condition. The husband in reply to a query writes that she is well. Attends to her household duties, eats and sleeps well. Dislikes the company of members that are not of the family, and avoids participating in social functions where there are large number of people.

The following table shows the distribution of cases according to the duration of disorder.

#### RESULTS OF LEUCOTOMY IN RELATION TO 'DURATION OF ILLNESS' (50 CASES)

Duration of disorder	Recovered	Improved	Unchnaged	Readmitted	Remaining	Dead	Not traced
0—1 year	3	1	1	1	1	1	1
1—5 years	5	5	3	2	1	...	...
5—10 "	1	3	1	...	2	1	...
10—15 "	1	2	2	...	1	...	...
15—20 "	1	2	...	1	1	1	...
Not known	...	2	...	1	2	...	...
Total ...	11	15	7	5	8	3	1

These figures indicate that the best results are obtained in those cases where the duration of disorder is between 1—5 years, though improvement has been noticed in some cases where the duration has exceeded 10 years.

The following table shows the distribution of cases according to the disease process.

# RESULTS OF LEUCOTOMY IN RELATION TO 'NATURE OF ILLNESS' (50 CASES)

	Schizophrenia	Catatonic	Paranoid	Affective Reaction	Mental Defect	Total
Recovered ...	4	..	..	7	..	11
Improved ...	5	..	..	10	..	15
Unchanged ...	1	1	3	1	1	7
Readmitted ...	2	..	..	3	..	5
Remaining ...	1	..	6	..	1	8
Dead ...	..	..	..	3	..	3
Not traced ...	1	..	..	..	..	1
Total ...	14	1	9	24	2	50

The above table suggests that the greatest improvement occurs in those showing an affective reaction. The schizophrenics show good response, while the catatonics and the paranoid states showed practically no improvement.

The failure of improvement in operated cases can be attributed to two main causes. One is due to the duration of the disease and degenerative changes in the brain which will have supervened consequent on the illness. In such cases obviously it is not possible to expect any marked improvement. The other cause is due to the plane of section being far too anterior to the plane of critical section. If the cut is too anterior no improvement results, and cuts made posterior to this plane are dangerous, and often produce permanent motor damage, sphincteric disturbances, epileptiform seizures, etc. Freeman and Watts have subjected about 20% of their cases to a second and sometimes a third operation, the sections being made posterior to the previous operation. They have found improvement

after the second or even third operation, and recommend it in cases which have not responded to the first operation. Our experience is limited to one case, submitted to a second operation where more extensive sections of the white matter than at the first operation was done, and a small quantity of absolute alcohol was injected into the sectioned area. The patient is alive and though slight improvement is noticeable, it is too early to hazard an opinion on one case only. It is intended to perform a second operation on a few more cases who have failed to show any improvement after the first operation.

Criticism of this operation is neither wanting nor unexpected. But as more workers in the field have demonstrated the usefulness of the operation, and the hopeless cases at least have a chance of improvement, hostility to the operation is gradually fading.

The future of psycho-surgery is uncertain. Without a precise knowledge of the mechanism underlying the various mental processes both normal and abnormal, one can only surmise as to the method of treatment or the possible outcome of such treatment. Certain mental disorders appear to have some sort of racial characteristics, and sufficient reports of this method of treatment appears desirable in our country before the true position of psycho-surgery could be assessed.

I take this opportunity to thank Dr. V. V. Monteiro whose kind encouragement, made this work possible. My thanks are also due to Dr. M. V. Govindaswamy, Superintendent, Mental Hospital, Bangalore, for enthusiastic co-operation in conducting this work.

In conclusion Mr. President, Ladies and Gentlemen, I thank you for the patient hearing you have given me, and if this brief description has evoked the enthusiasm of my fellow workers to try this method, the purpose of this lecture would have been more than served.

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### Registry of Sarcoma of Bone

It was decided at the last Conference that a Registry of Sarcoma of Bone is to be maintained under the auspices of the Association. Dr. V. R. Khanolkar of the Tata Memorial Hospital, Bombay, has very kindly consented to make the necessary Pathological study of Specimens. All Surgeons are, therefore, requested to send short but complete notes of cases of Sarcoma of Bones under their care to Dr. Khanolkar along with X-Ray and Clinical photographs, if any, and a piece of embedded tissue or two unstained slides. It is particularly requested that all Surgeons will co-operate in this endeavour.

### The Library

The attention of all members is invited to the Circular regarding the Library. A separate account has been opened and donations and subscriptions may be sent to the Secretary. Suggestions regarding books and journals to be acquired are welcome. Donations will be acknowledged in the Journal from time to time.

### List of Donors

(Since publication of the previous list)

Capt. V. L. Suryavanshi	..	Rs.	50	0	0
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### Subjects for Discussion

#### 8th Meeting :

##### 1. Carcinoma of the Rectum—

Opener : Dr. C. P. V. Menon, Madras.  
Seconder : Dr. E. J. Borges, Tata Memorial Hospital, Bombay.

##### 2. Carcinoma of the Cheek—

Opener : Dr. B. M. Joly, Delhi.  
Seconder : Dr. K. M. Rai, Madras.

##### 3. Hare Lip and Cleft Palate—

Opener : Dr. S. C. Sinha, Calcutta.  
Seconder : Dr. M. G. Kini, Madras.

#### 9th Meeting :

##### 1. Bone Tumours—

Opener : Dr. D. R. Meher Homji, Bombay.  
Seconder : Dr. M. G. Kini, Madras.

##### 2. Intracranial Tumour—

Opener : Dr. A. V. Baliga, Bombay.  
Seconder : Dr. R. N. Cooper, Bombay.

##### 3. Burns—

Opener : Dr. M. R. Munawar Ali, Hyderabad.  
Seconder : Dr. G. M. Phadke, Bombay.

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## INFECTIONS OF THE FOOT\*

by V. RAMACHANDRA RAO, M.B.B.S., Stanley Hospital, Madras.

### 1. Introduction

The Problem of 'Infections of the Foot' has not received the same attention as that of 'Infections of the Hand' in Western countries. A good deal of work has been done with regard to infections of the hand as the prehensile function of the hand makes it susceptible to injuries and infections with ultimate limitations of function and even loss of certain important and fine movements. The Foot acts as a support and helps stability and locomotion, and being well protected, by a thick layer of fat in the sole and a boot or a shoe in addition, is not liable to injuries and infections. Perhaps this accounts for the lack of interest in the investigation of infections of the Foot in Western countries. In India, however, particularly in the south, most people go barefooted and the Foot is more exposed to injury and infection. Protecting nervous reflexes in the hand help in withdrawing it quickly. But the Foot has to wait transference of the gravitational weight to the other limb before it can be withdrawn. Thus a split second is enough to cause many a road accident and being bare as it is in India the Foot gets easily injured and often seriously infected. The tropical climate also has a special bearing on the production of a variety of clinical manifestations.

### STATISTICAL REVIEW

On the average about 21.1 per cent of the new cases that attend the surgical outpatient department in our hospital suffer from some surgical condition or other of the Foot.

In the month of September 1943 the total number of patients that attended the Sur-

gical Out-patients was 1758 including males, females and children. Of these, 384 patients sought treatment for some surgical condition or other of the Foot. This gives a percentage of 21.8. The corresponding figures for October 1943 were 351 cases out of 1624 giving a percentage of 21.5. In June 1945, the figures were 299 out of 1505—a percentage of 19.9. This shows the high affections of the foot (Fig. 1).

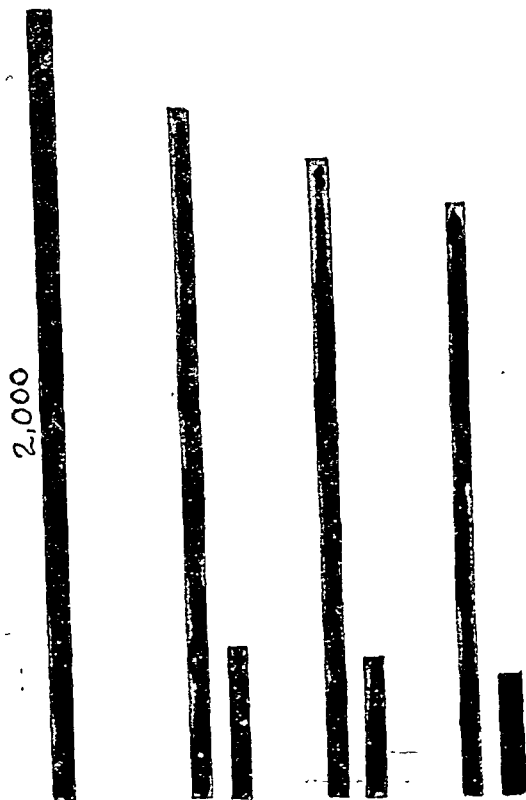


Fig. 1. Long Column shows the Total Attendance of Surgical Cases. Short Column indicates the No. with Foot Involved.

\*Prize Essay.



TABLE I  
TOTAL NUMBER OF PATIENTS WHO  
ATTENDED THE SURGICAL OUT-  
PATIENT DEPARTMENT

Month & Year	Males	Females & Children	Total
September 1943	1156	602	1758
October 1943	1121	503	1624
June 1945	994	511	1505

TABLE II  
NUMBER OF PATIENTS PRESENTING  
A SURGICAL CONDITION OF FOOT

Month & Year	Ulcers		Abscesses		Infective conditions	Injuries	Total
	Acute	Chronic	In Heel	In other parts			
Sept. 1943							
Males		23	13	15		220	271
Females & children		10	8	15		80	113
Total ...		33	21	30		300	384
June 1945							
Males	15	35	8	8	8	149	223
Females & children	7	18	6	5	9	91	76
Total ...	22	53	14	13	17	180	290

TABLE III

Month & year	Total No. of patients attending the Surgical Out-patients	Total No. with Foot involved	Percentage
September 1943	1758	384	21.8
October 1943	1624	351	21.5
June 1945	1505	299	19.9
Average ...			21.1

The first paper on 'Infections of the Foot' was written by Grodinsky entitled 'Fascial spaces and tendon sheaths of the Foot and

their bearing on Infections of the Foot' and was published in 1929 and 1930 in Surgery, Gynaecology and Obstetrics. In the next year, Grodinsky published another paper entitled 'Foot Infections of Peridigital origin' in the Annals of Surgery. Barring these papers, it can be said that very little has been written concerning 'Foot and its Infections.' In recent years however, many papers are being published in various Indian journals on 'Naga Sores or Tropical Ulcers in the Foot and Leg' throwing light on the aetiology and suggesting methods of promoting effective and rapid healing of these ulcers.

## 2. Anatomy of the Foot with particular reference to Foot Infection

### I. FASCIAL SPACES OF THE FOOT

Grodinsky has described 11 fascial spaces of which 9 are in the foot and 2 in the leg. Of these 9 spaces in the foot, 7 are in the sole. There are 4 median plantar spaces, 1 medial and 1 lateral plantar space and another in connection with the lumbricals—the lumbrical space. The two dorsal spaces described are the dorsal subcutaneous and the sub-aponeurotic. Of the two spaces in the leg one is the medial leg space which is between the superficial and deep calf muscles brought into relation with the foot by the long flexor tendons behind the medial malleolus and the other the lateral leg space, deep to the sheaths of the peroneal tendons which extend behind the lateral malleolus towards the foot.

With the object of defining and determining the extent of these spaces, their relation with one another and with the tendon sheaths, dissection and injection work was carried out on ten limbs, including fresh and preserved.

A description of the various foot spaces is given below. Among the four median plantar spaces three are between the four layers of the muscles and one between the first layer and the plantar aponeurosis. They are described as M-I, M-II, M-III, and M-IV.

## MEDIAN PLANTAR SPACE I—M-I

(Figure 2, 3.)

This space is deep to the central part of the plantar aponeurosis and superficial to the flexor digitorum brevis muscle. The lateral and medial boundaries are connective tissue down growths from the plantar aponeurosis which are continuous with those of M-II. Posteriorly, the aponeurosis

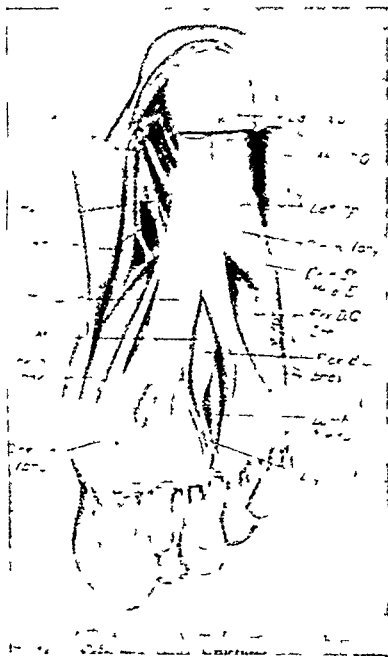


Fig 2 Superficial plantar view of human foot, showing plantar aponeurosis and related structures

and the flexor digitorum brevis are closely united together. Proximal to the level of the midtarsal joint the central part of the plantar aponeurosis and the flexor digitorum brevis are strongly bound together and any attempt to separate them lacerates the one or the other. The space does not extend posterior to this level for all practical purposes. The compartment ends anteriorly at about the level of the middle of the metatarsal bones where the fasciae covering the floor and the aponeurosis fuse together. Along the length of the space fine but fairly firm connective tissue septa go down

from the deep aspect of the aponeurosis into the fascia over the flexor digitorum brevis thus dividing the space into four antero-posterior compartments, there being one proximal to each of the four subcutaneous spaces between the slips of the plantar aponeurosis. Distally these septa are incomplete and hence all the four compartments freely communicate with each other. This has been made more evident during injection work when the fluid distends the space part by part and in an anteroposterior direction.



Fig. 3 Both Feet—The central part of the plantar aponeurosis reflected in two flaps to the sides exposing the median plantar space M-I Flexor Digitorum Brevis is seen in the floor. In both feet plaster mass injected into the heel is seen the mass in the right foot colour-painted for better definition.

Grodinsky has further stated in his paper that "each of the four compartments is partially subdivided by partially incomplete transverse septa particularly at the level of the base of the fifth metatarsal bone where the first and fourth end proximally. The second is the longest and extends posteriorly to within two or three centimeters of the medial tubercle of the calcaneus. The third is the shortest and runs into the second 2.5 cms. distal to the base of the fifth metatarsal bone." These details could not be appreciated during my dissection work.

Thus the medial plantar space M-I is of the shape of a trapezium. The fascia lining the floor and the roof of these compartments fuse anteriorly and can be easily separated particularly about the digital nerves which emerge from M-I deriving a fascial covering from its floor and pass into the subcutaneous interspaces.

### MEDIAN PLANTAR SPACE II—M-II

(Figure 4 and 5)

This space is triangular in shape, superficially bounded by the flexor digitorum brevis and the plantar aponeurosis and deeply, by the quadratus plantae muscle joined medially by the flexor digitorum longus tendon. It lies between the fascial sheaths of the two muscles mentioned above and their reflexions at the periphery.

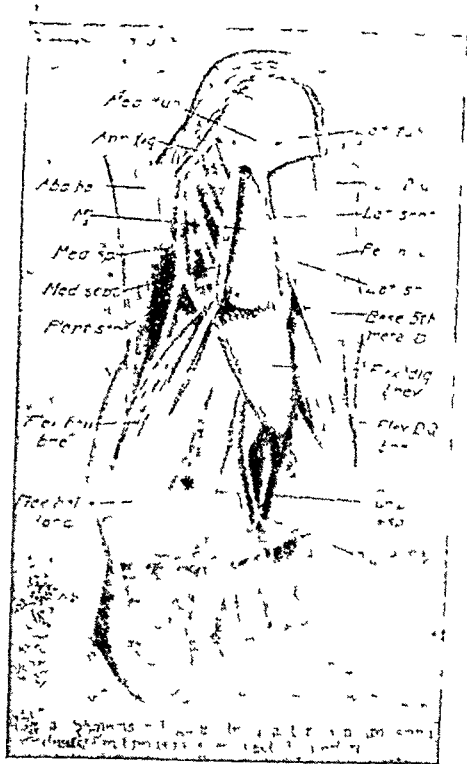


Fig. 4. Same as in Figure 2 but plantar aponeurosis and flexor digitorum brevis muscle reflected anteriorly.

The apex of the space is about one centimeter anteromedial to the medial tubercle of the calcaneus. Laterally, it is limited by the connective tissue septum which goes

down from the plantar aponeurosis and bounds likewise M-I and M-III. Medially it is limited by the septum that goes down from the medial margin of the central part of the aponeurosis and likewise bounds M-I, M-III and M-IV. Anteriorly, it extends as a distinct space only upto a line opposite the base of the fifth metatarsal bone where



Fig. 5 Both Feet—Flexor Digitorum Brevis reflected in two flaps (anterior and posterior), exposing M-II.

Left Foot—Note plantar vessels and the lateral plantar nerve coursing across the space antero-laterally. Still anteriorly the tendons of the long flexor digitorum to the toes are seen.

Right Foot—The plaster mass injected into M-II is seen. The nerve and vessels are seen coursing across the space superficial to the mass.

the fascia of the roof and the floor are joined by loose areolar tissue, thus forming the base of the triangular space. This loose areolar tissue can be easily broken through when it will be found that the space extends into the interspaces between the slips of the plantar aponeurosis (Vide page 12).

## MEDIAN PLANTAR SPACE III—M-III

(Figure 6 and 7)

This is another triangular space deep to M-I and M-II. The roof is formed by the deep surface of the quadratus plantae muscle. The floor consists of tarsal bones and ligaments posteriorly, the tendon of the peroneus longus with its synovial sheath in the middle and the adductor hallucis obli-

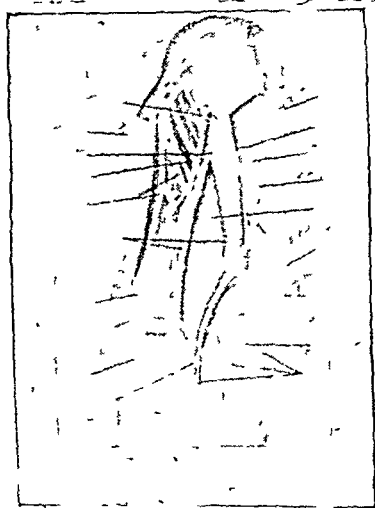


Fig. 6.

qus and the plantar and dorsal interossei between the third, fourth and fifth metatarsals, anteriorly. The medial limitation is the same connective tissue septum going down from the plantar aponeurosis and bounding M-II, M-I and M-IV. Due to the concavity of the main arch of the foot and in conformity with one half of the transverse arch in each foot, the lateral boundary consists chiefly of the tarsal bones and ligaments (especially the long plantar ligament) posteriorly and the third plantar and fourth dorsal interossei, anteriorly. The apex of the space is about 2 or 3 cms. anterior to that of M-II, i.e., about 3 to 4 cms. anteromedial to the medial tubercle of calcaneus, being more anterior than medial. The anterior extent of the base of the space is along a line passing through the middle

of the fifth metatarsal bone and the head of the first one. Further anteriorly the two fascial linings are separated by loose areolar tissue which can be easily separated.



Fig 7. Left Foot—Skin and subcutaneous tissues removed. The abductor digiti quinti and abductor hallucis detached from their calcaneal attachment, and thrown to the sides thus exposing the medial and lateral plantar spaces

The central part of the plantar aponeurosis and the flexor digitorum brevis are also removed. The long flexor digitorum cut across and thrown forward exposing M-III. Note the abductor hallucis obliquus in its distal part. The medial and lateral plantar septa are demarcated

This space M-III thus extends forwards like M-II and M-I in between the slips of the plantar aponeurosis towards the lateral four toes (Vide page 12).

## MEDIAL PLANTAR SPACE IV—M-IV

(Figure 8 and 9)

This is a potential space deep to the Adductor Hallucis obliquus and superficial to the first dorsal interosseus in the first metatarsal interspace, the proximal half of the first plantar and second dorsal interossei in the second space and the proximal ends of the second plantar and third dorsal interossei in the third interspace. The medial connective tissue septum going down and getting attached to the lateral side of the first metatarsal bone along its length splits to enclose the Adductor Obliquus Hallucis,

with its sheath is in relation to the lateral plantar space (vide page 8). Thus it can be seen that infection in the sheath can spread into one or all of these spaces. M-III is a very important space in the sense that it communicates with lateral plantar space as stated above, and with the medial plantar space deep to the flexor hallucis longus and

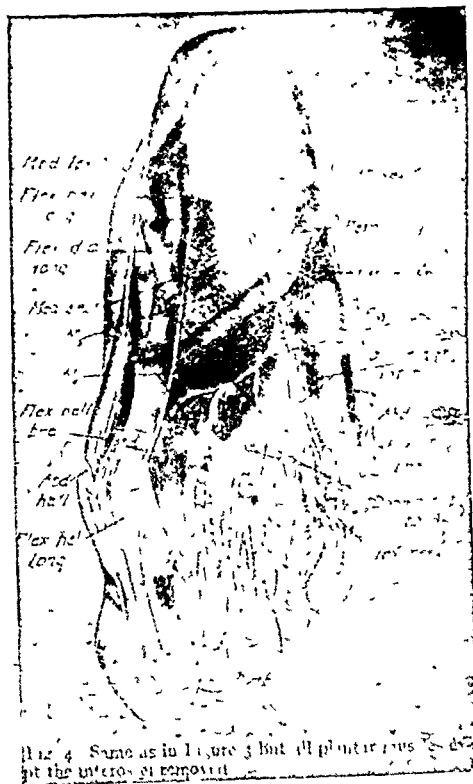


Fig. 8.

to M-IV (the proximal parts) and the plantar metatarsal vessels take their origin there. The deep branch of the lateral plantar nerve follows the arch across the space.

The peroneus longus tendon with its sheath, (vide page 10) as it courses across the foot obliquely, is in relation to M-III, being in its floor. Also, it is proximal to M-IV by virtue of the muscle taking origin from the tendinous fibres that invest the tendon. In its proximal part this tendon

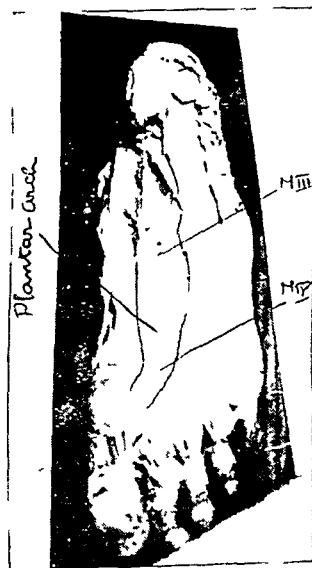


Fig. 9. Left Foot.

The Abductor Hallucis and the Abductor Digiti quinti removed. The flexor tendons severed at a level just proximal to the necks of the metatarsals. The abductor obliquus also removed. M-III and M-IV are visualised. The plantar arterial arch is seen in the floor of M-IV.

the flexor digitorum longus tendons as they pass through its medial wall. M-IV is virtually in M-III. Infection can spread through the interossei into the dorsal sub-aponeurotic space due to the absence of any definite fascial layer covering the metatarsals and the interossei (vide page 13).

# THE LUMBRICAL AND SUBCUTANEOUS INTERSPACES

The central part of the plantar aponeurosis divides near the head of the metatarsal into five slips which pass on to the toes. One slip goes to the root of each toe where it divides into two slips which embrace the flexor tendons and become fixed

to their sheaths and to the transverse metatarsal ligament on each side of the toe. All the five processes are held together by transverse fibres, and between them appear the digital vessels, nerves and the lumbrical muscles. From the deep surface of each slip pass firm connective tissue septa. The interspaces between these slips of plantar aponeurosis are occupied by subcutaneous fatty tissue which is a part of the superficial fascia. In the substance of this fascia run the common digital nerves surrounded by their fascial sheaths derived from the fascial floor of M-I. They are joined distally by the plantar metatarsal vessels which become superficial near the necks of the metatarsal bones. If the nerve and the vessel be dissected out and cleared of the superficial fascia, the lumbrical muscles are exposed covered by a fairly firm layer of fascia extending between the lateral walls of the lumbrical grooves. Superficial to this fascia these subcutaneous interspaces can be traced proximally upto the place where the central part of the aponeurosis divides into strips. At that level fairly dense connective tissue is seen to bind the deep part of the plantar aponeurosis to the fascia below. When this is teased, it is found to open into M-I—into each one of its four common compartments, wherein emerge the common digital nerves from M-I deriving a sheath from its floor. When the fascia covering the lumbrical grooves is removed the lumbrical muscles are exposed, each enclosed in a thin fascial sheath which is derived from the floor of the M-II space as they arise from the digital slips of the long flexor tendon. The slips of the flexor digitorum brevis cross the lumbrical muscles at their origin superficially from the medial to the lateral side. The digital slips of the longus digitorum are always to their lateral side. Both the flexor tendons of each toe are lateral to the lumbrical tendon in their distal course. These flexor tendon slips derive their own fascial sheaths from the muscles from which they arise. These correspond to the paratendinous sheaths of the hand and are reinforced by the deep bands from the plantar aponeuro-

sis to form the lateral walls of the lumbrical tunnels. This is in agreement with Grodinsky's findings (Fig. 2, 4, 11).

This potential space between the lumbricals and their fascial sheath is separated from M-II by a thin layer of loose areolar tissue which easily breaks through and thus connects one with the other. Distally the lumbrical tendon while gaining insertion into the dorsal expansion extends into the dorsal subcutaneous region. The lumbrical space communicates with the dorsal subcutaneous space also. Deep to each lumbrical muscle and its sheath lies loose areolar tissue which when traced proximally is found to be the same as that which lies below the fascia covering M-III space and binds them down loosely. (vide page 13).

#### MEDIAL PLANTAR SPACE

(Fig. 2, 4, 10, 7)

The Medial Plantar Space is the potential space deep to the Abductor hallucis muscle—between it and its sheath. It extends from the origin of the muscle from the calcaneus to its fusion with the medial head of the flexor hallucis brevis muscle. The fascial sheath deep to this space forming its floor covers the posterior tibial vessels and nerves and the tendons of the long flexors of the digits and the hallux as they emerge from behind the medial malleolus and pass to the sole of the foot. Deep to this fascial sheath or a little higher up the posterior tibial structures divide into the terminal medial and lateral plantar branches. The space is limited medially by the fusion of the fascial layer deep to the muscle and the medial border of the muscle itself. While laterally the same fascia fuses with the medial fibrous down growth from the plantar aponeurosis.

#### LATERAL PLANTAR SPACE

(Fig. 2, 4, 10, 7)

It is the potential space underneath the abductor digiti quinti muscle. It is enclosed in the fascial sheath of the muscle deep to



sheath is very close to the end of the tendon, i.e., just proximal to its insertion into the distal phalanx beyond the interphalangeal joint. The proximal extent of the sheath is 1.5 to 2 cms. proximal to the prominent part of the head of the metatarsal bone. As in the hand, this serous sheath is bound down to the sides of the phalanges and to the head of the metatarsal bone by a surrounding fibrous sheath. The fibrous sheath stops short about  $\frac{1}{2}$  cm. distal to the proximal end of the synovial sheath thus leaving a small portion of it unprotected, where it is more susceptible to perforation.

(b) Both the long and short flexor tendons of each of the second, third, fourth and fifth toes are enclosed in a single synovial sheath which extend distally to just beyond the distal interphalangeal joint. The proximal ends are about 1 to 1.5 cms. proximal to the heads of the metatarsal bones. Here also the serous sheaths are bound down to the phalanges and protected by a fibrous sheath which is deficient in the proximal end leaving about  $\frac{1}{2}$  to 1 cm. of the serous sheath exposed and unprotected.

The tendon sheaths consist of two parts: an outer fibrous sheath and an inner synovial sheath. In the case of the flexor tendons of the toes the outer fibrous sheath is really an osseo-aponeurotic tunnel (Fig. 14)

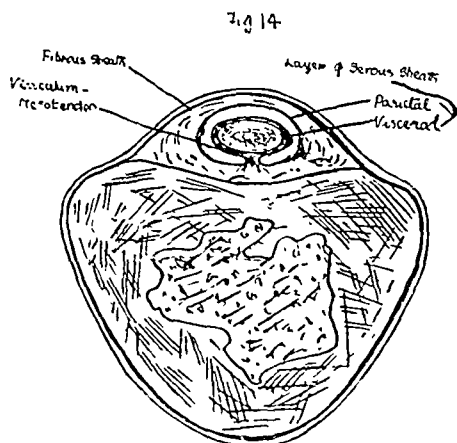


Fig. 14. Cross section through the distal end of the 1st phalanx of the great toe showing the relation of the visceral and parietal layers of the serous sheath of the long flexor tendon.

whose superficial and lateral walls are fastened by firm fibrous tissue and whose deep walls are fastened to the periosteum covering the phalanges. Opposite the proximal and middle phalanges, the superficial and outer walls are fastened by firm transverse bands of fibrous tissue. Opposite to the interphalangeal joints the walls are much thinner and composed of annular and cruciate fibres. The fibrous sheaths hold down the flexor tendons to the underlying bones during the movements of the toes. The synovial sheath forms a complete lining from the fibrous sheath and is reflected on to the tendon to form a smooth shining investment for the tendon.

## (ii) SHEATHS ABOUT THE LONG FLEXORS BEHIND THE MEDIAL MALLEOLUS

(a) *Sheath of the flexor hallucis longus*—the proximal end lies  $\frac{1}{2}$  to 2 cms. above the tip of the medial malleolus. The distal end extends just beyond the crossing of this tendon by that of the flexor digitorum longus muscle about 5 to 6 centimeters antero-inferior to the tip of the medial malleolus.

(b) *The sheath round the tendon of the flexor digitorum longus*.—This tendon lies anterior and superficial to that of the flexor hallucis longus. The upper extent of the sheath is level with the upper border of the medial malleolus (about 2 cms. from the tip of it) and extends where it crosses the tendon of the flexor hallucis longus in the sole (about 4 to 5 cms. from the tip of the medial malleolus).

(c) *The sheath of the tendon of the tibialis posterior*.—The tendon of the tibialis posterior is the most anterior of the three tendons behind the medial malleolus; distally it extends almost to the point of its main insertion to the tubercle of the navicular (1.5 to 3 cms. antero-inferior to the tip of the medial malleolus).

In one of two cases, there was a communication between the sheath of the flexor hallucis longus and that of the flexor digitorum longus where the latter crossed the



former in the foot (M. Grodinsky 1930). In two out of 7 cases the communication was observed by Poirier and Rouviere (1912). The sheath of the flexor digitorum longus tendon may communicate with that of the tibialis (posterior (M. Godinsky—one case 1930). In one of the four limbs dissected the tendon sheath of the flexor hallucis longus communicated with that of the flexor digitorum longus. The communication between the flexor digitorum longus and the tibialis posterior was not observed in any of the four cases.

The tendon of the flexor hallucis longus muscle in its course under the anular ligament passes through a fibrous canal deep to the posterior tibial nerve and vessels.

*The Ligamentum Laciniatum*: bridges across the hollow between the medial malleolus and the medial prominence of the calcaneus, and it attached to both. Its proximal border is continuous with the deep fascia covering the superficial muscles of the calf and also with the septum which separates these muscles from the deeper muscles of the leg. The septum takes a more important part in the formation of the ligament than the more superficial layer of deep fascia. Its distal or anterior margin is continuous with the medial part of the plantar aponeurosis and it gives attachment to the abductor hallucis muscle. The tendons that are deep to it are isolated from one another and from the vessels and nerve by septa which pass from the deep surface of the ligament to the ridges on the adjacent bones.

### (iii) SHEATHS AROUND THE PERONEUS LONGUS AND BREVIS AS THEY PASS BEHIND THE LATERAL MALLEOLUS

The two tendons have a common serous sheath to start with, which divides distally into two divisions one for each tendon. The proximal end of the common sheath lies three to six cms. above the tip of the lateral malleolus. The sheath of the brevis tendon is anterior to that of the longus in its lower portion. The distal end of the brevis divi-

sion extends to very near its insertion. In one half of the specimens it extended to almost its insertion into the base of the fifth metatarsal and the other half to a point midway between the tip of the malleolus and the point of its insertion (Grodinsky). Distally the longus sheath ends obliquely, extending further into the foot on the deep side than on the superficial side. Superficially it ends where the tendon bends sharply into the sole—a point 2 to 3 cms. distal to the base of the fifth metatarsal bone or 3 to 4 cms. inferior to the tip of the lateral malleolus. In two out of four cases the sheath of the peroneus brevis extended to the base of the fifth metatarsal bone. In the third case it stopped short  $1\frac{1}{2}$  cms. and in the fourth 4 cms. from the base of the fifth metatarsal bone.

As the tendons of the two peronei muscles proceed distally, in the hollow between the lateral malleolus and the posterior prominence of the calcaneus, they are held in place by the SUPERIOR PERONEAL RETINACULUM and their movements are facilitated by the common synovial sheath enclosing them. On the lateral surface of the calcaneus, the tendons are retained in position by the INFERIOR PERONEAL RETINACULUM, but each tendon lies in a separate compartment with a separate synovial sheath prolonged from the common peroneal sheath. The trochlear process of the calcaneus intervenes between the two tendon sheaths of the peronei when that of the brevis is higher than that of the longus.

### (iv) PLANTAR SHEATH OF THE PERONEUS LONGUS

Distally the plantar sheath extends almost to the insertion of the tendon on the first cuneiform bone and the base of the first metatarsal. The proximal portion may be in contact with the distal deep end of the malleolar sheath of the same tendon or may be about a centimeter distant from it. The two sheaths may communicate rarely (one in 7 cases—Grodinsky, Poirier and Rouviere—frequently, 1912). This plantar peroneal sheath is incompletely enclosed in



extremity to allow telescoping in at one end and out at the other or vice-versa."

### III. RELATION OF THE VESSELS AND NERVES AND THE TENDONS IN THE FOOT TO THE FASCIAL SPACES AND THE RELATION OF ONE FASCIAL SPACE OR SHEATH TO ANOTHER

The plantar vessels and nerves are in the medial leg space, and in the sole of the foot they are still in it, and deep to the fascial floor of the medial plantar space. The medial plantar nerve passes towards the medial plantar septum and courses forward along it anteriorly. It divides into two branches about 2 or 3 centimeters from the calcaneus. The medial branch becomes the digital branch to the inner side of the great toe passing round the adductor hallucis and coursing superficial to it. The inner branch bulges into M-I but is separated from it by the fascial septum. It passes round the border of the flexor digitorum brevis and enters the M-I space. In the space it divides into the three common digital branches. It emerges from M-I deriving a fascial sheath from its floor and enters the interdigital subcutaneous space.

The medial plantar artery and its vena comitans accompany the nerve, dividing into branches and following the same course as the nerve. The common digital branches anastomose with the plantar, metatarsal branches from the plantar arch which become superficial in the subcutaneous interspace at the level of the neck of the metatarsal bones.

The lateral plantar vessels and nerves pass through the medial plantar septum into the M-II space and course anteriorly and outwards above the space deep to the fascia covering the quadratus plantae muscle. A branch is given off by the medial plantar artery in this part of its course which in turn passes through the lateral septum. The main trunk of the artery itself pierces the lateral septum at a point midway between the medial tubercle of the calcaneus and the base of the fifth metatar-

sal bone. It then passes between that septum (lateral to it) and the sheath of the adductor digiti quinti. There it gives a branch which passes into the lateral space. Again, about 2.5 cms. proximal to the base of the fifth metatarsal bones, it pierces the septum and passes into the M-III space across the interossei. As it reaches the lateral border of the adductor hallucis obliquus it passes deep to it forming the plantar arch. It gives off its metatarsal branches in M-III and it gives a branch to the lateral side of the little toe. The vena comitans follow the artery and its branches. The lateral plantar nerve accompanies the artery and pierces the lateral plantar septum distally to where the vessels pierce it. Opposite the base of the fifth metatarsal bone it divides into a superficial and a deep branch. The latter accompanies the vessel and forms an arch as it comes into M-III and deep to M-IV. The superficial branch divides into an outer branch to supply the outer border of the little toe and an inner which winds round the lateral border of the flexor digitorum brevis and gains access into M-I. From there it enters the interdigital subcutaneous cellular space as the other three from the medial plantar.

The long flexor tendon of the toes and that of the hallux cross one over the other over the tarsal bones proximal to the base of the first metatarsal bone and enter M-II passing through the medial septum. The septum is adherent firmly to the sheaths of these tendons. However that is a weak area there.

Thus it will be appreciated that the tendons and the vessels and nerves by their passage through the septa make it possible for the medial leg space to be in communication with M-I and M-II. The interdigital subcutaneous interspace lodges the digital sheath and the lumbrical. So this space communicates with M-I along the common digital nerves, with M-II along the lumbricals and with M-III deep to the lumbrical space through the loose areolar tissue and along the metatarsal branches of the plantar arch. The lumbricals bring M-II

into communication with the dorsal subcutaneous space. Unlike in the hand, there is no plantar interosseous or thick fascial layer covering the interossei. Hence M-III and M-IV communicate with the dorsal sub-aponeurotic space—particularly facilitated by the dipping in of the terminal branch of the dorsalis pedis artery into the sole which goes to complete the plantar arch. The M-IV space is virtually in the M-III space in its anterior and medial portion so much as to say that M-III potentially extends deep to the fascial floor of M-IV in its entirety. The lateral leg space can communicate with M-III through the passage of the long peroneus into the sole of the foot across the floor of M-III. So also the medial leg space can communicate with M-IV and M-III along the posterior tibial tendon through its fasciculi gaining insertions into the various tarsal and metatarsal bones.

The lateral and medial plantar septa form the common boundary, laterally and medially, of M-I, M-II and M-III and medially only of M-IV. These spaces are between the layers of the muscles and are limited by their fascial sheaths. These sheaths fuse with these septa on either side. So any collection in these spaces if not let out will easily gain entrance into the other ones below and above. Thus the M-II and M-III spaces communicate very easily, M-III with M-II and *vice versa*. The contents in M-I do not so easily communicate with the M-II space or superficially burst out, but find easy escape into the subcutaneous interdigital space. Once an infection gets into this space or starts there it will spread into all the three spaces, M-I, M-II and M-III. If the lumbrical spaces are involved invariably the dorsal subcutaneous spaces in the dorsum of the webs will also be involved. The oedema in the dorsum will be considerable.

The sheaths of the long flexor tendons behind the medial malleolus are in relation to the medial leg space. The sheath of the flexor hallucis longus in this connection is deep to the medial plantar space and medial to M-II and M-III. The common paroneal

sheath is in relation to the lateral space. The sheath of the peroneus longus in the sole comes into relation with M-III.

The lumbrical grooves are to the medial side of the digital sheaths of the outer four flexors tendons. The digital vessels with a separate sheath of fascia are superficial to the digital sheaths and the lumbrical grooves and between them, however separated from them by a fairly fixed layer of fascia. M-II is traceable along each digital slip in connection with the outer four toes.

The extensor tendon sheaths are in the sub-aponeurotic space over the dorsum of the foot.

#### IV. INJECTION EXPERIMENTS

The material used for injection purposes was plaster of Paris mixed with glycerine and water and made into a thin paste. The admixture of glycerine helps slow setting of the plaster and facilitates injection with

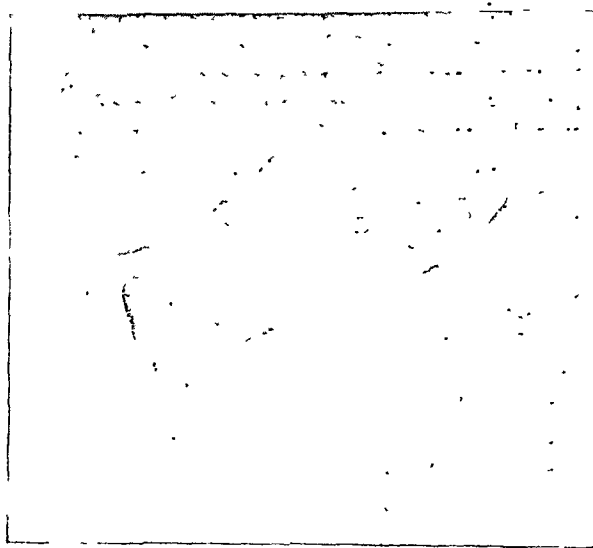


Fig. 15.

the syringe. The mixture was injected into the various spaces using a glass syringe and a needle of wide bore. The plaster was allowed to set and an x-ray taken to define the limits of the spaces in the skiagram. Next, dissection was carried out to demon-

Fig. 16, 18, 23. *Subcutaneous tissue space in the heel*: The needle was inserted into

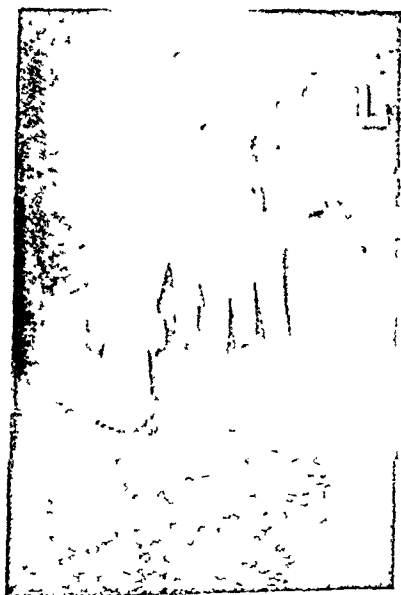


Fig. 22.

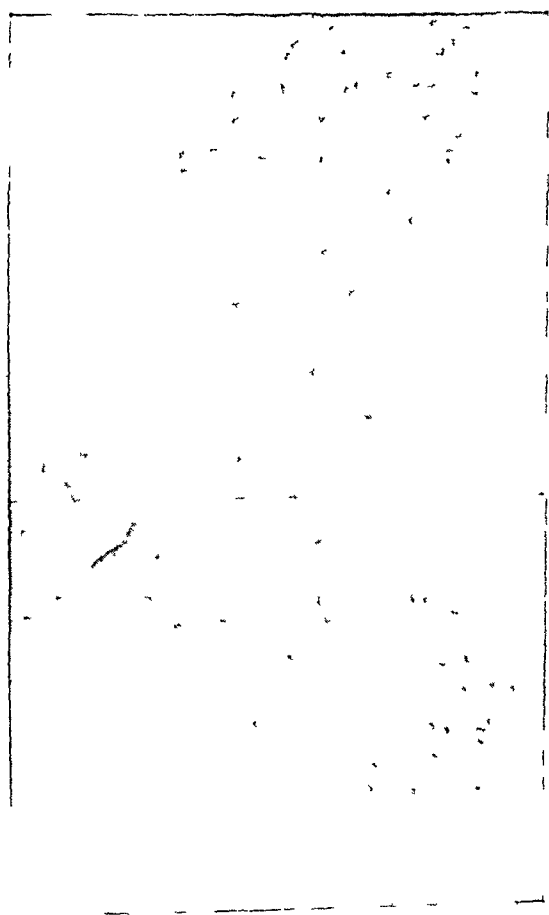


Fig. 23.

the central part of the heel and the fluid injected into the subcutaneous tissue. The fluid went in under great pressure and in jerks, a small quantity at a time suggesting that some resistance is suddenly being overcome. The fluid escapes into a fresh small area every time.

It was noted while dissecting the foot that the thick pad of subcutaneous fat in the heel is granular in structure, being lodged in the mesh work of strongly inter-woven fasciculi extending from the under surface of the thick skin to the deep fascia.

The x-ray shows in the lateral view (Fig. No. 23, 16, 18.) the plaster mass deep to the skin and superficial to and separated from the calcaneus. Note the beaded condition of the injected mass and the antero-posterior extent of it.

Grodinsky has described in detail how the injected mass spreads after bursting through the spaces and sheaths, thus throwing more light on the modes of spread of infection from one space or sheath to another. This part of the experimental work however has not yet been done. When special facilities are accorded for a thorough and more detailed study on a larger scale these anatomical and experimental observations will be correlated with the clinical picture, and the postmortem findings as well wherever possible. A scheme has been drawn up and sent to concerned authorities for approval for further prosecution of this work.

## V. INCISIONS FOR DRAINING FASCIAL SPACES AND TENDON SHEATHS

(a) *Fascial Spaces*—M-I—Incision has to be on the plantar side. But it is disadvantageous in the sense that the sensitive scar is subject to pressure on walking. If the incision is made on the medial side in the middle portion where it does not rest on the ground and if the space is drained through that incision it would be less painful. One has to remember the various septa that divide the space into compartments and has to break them to effect thorough drainage.

**M-II**—Central or median plantar is inadvisable as it develops a painful scar. Moreover, the space can be reached only by going through the flexor digitorum brevis with the result that the drainage will be poor, and later there is a possibility of loss of function.

**M-III and M-IV**—The same objection as observed in connection with M-II holds good. It is better to approach M-II, M-III and M-IV from the medial sides of the foot. "An incision may be made along the medial border of the foot and a haemostat passed deep to the adductor hallucis and flexor hallucis brevis to reach the medial connective tissue septum; depending upon the space infected, the haemostat can be directed through the septum into the particular space involved and drainage effected. This has another advantage because through the same incision any one or all of the three spaces can be drained." It may be remembered that if infection gets in any one of these three spaces, it is almost certain to involve the other two.

**Lumbrical Spaces**—Just as in the hand, the incision should extend from the medial side of the proximal phalanx to the proximal end of the space concerned. If there is extension into the dorsal subcutaneous space, the incision should be extended dorsally from its distal end. As most of the lumbrical space infections are accompanied by involvement of the median plantar spaces it may be necessary to open the latter from the proximal end of the lumbrical incision. However, it will be ideal to institute drainage of these spaces separately from the medial side.

**The medial and lateral spaces.**—These are approached with convenience through their medial and lateral walls.

**Dorsal sub-aponeurotic infections** are fairly localised, and can be opened dorsally by vertical incisions taking care not to injure the vessels and the tendons. If it is secondary to infection in M-III and M-IV, those spaces are to be opened first.

**Dorsal sub-cutaneous space.**—Once the infection localises, the area can be incised

and drained at its most dependant part because it is a superficial space.

**Deep Spaces of the Leg.**—The medial leg space is approached by making an incision on the medial side of the Tendo-Achillis and the incision may be extended proximally to facilitate drainage. The lateral leg space in connection with the peroneal tendon can be opened through an incision placed above and behind the lateral malleolus and extending it proximally or distally as indicated.

(b) **Tendon Sheaths.**—"Two facts are to be considered in the surgical treatment of tendon sheaths infection

(i) Drainage of the involved sheaths, and

(ii) Drainage of any fascial sheath which may be secondarily affected."

The digital sheaths should be opened following the same principle as laid down by Kanavel in draining the digital sheaths of the hand.

The long flexor tendons should be approached from behind the medial malleolus. A small incision is made over the point of greatest localisation in order to identify the sheath. Then the sheath is followed down to its whole length—a probe being used as a guide. It will be necessary to cut the annular ligament which would otherwise interfere with effective drainage. The posterior tibial vessels and nerves are to be identified and taken care of particularly while incising into the sheath of the flexor hallucis longus.

To drain the common peroneal tendon sheaths, the incision is placed directly over it just behind the lateral malleolus. The peroneal retinaculum should be cut to effect efficient drainage. The peroneal artery just behind the sheath is to be cared for while incising it.

**Peroneal Plantar Sheaths.**—The proximal end is explored and a haemostat introduced and opened. This prevents opening through all layers of muscles resulting in poor drainage and a painful plantar scar.

The sheath of the extensor tendons may be opened by placing an incision directly over them and extending the incision over the entire length of the sheath involved. This is facilitated by virtue of their being situated superficially. The anterior annular ligament also has to be cut in this connection.

These various incisions and the advantages thereof have to a great extent been described by Grodinsky.

## VI. COMPARISON OF THE FASCIAL SPACES BETWEEN THE HAND AND THE FOOT

Though there is much in common structurally between the hand and the foot, functionally there is lot of contrast between them. The fascial spaces only are compared and contrasted here in this chapter.

A. Medial plantar space M-III lies deep to the flexor digitorum longus tendons and the *accessories muscle*, while the tarsal bones and the ligaments, the tendon of the peroneus longus, a part of the oblique head of adductor hallucis and the plantar and dorsal interossei form the floor of it. The intermuscular septum projecting down from the medial borders of the central part of the plantar aponeurosis bounds the space medially. This can be compared with the mid-palmar space in the hand. That space also is behind the flexor tendons and lies upon the metacarpals and the interossei separated from them by a thin layer of fascia; but there is one difference. The oblique head of the adductor pollicis does not form the deep relation to the mid-palmar space, whereas a part of the oblique head of adductor hallucis is in the floor M-III.

B. In the hand the thenar space is mainly superficial to the transverse head of the adductor pollicis and partly to its oblique head. Whereas in the foot the transverse head of the adductor hallucis is thin and weak; it lies across the heads of the second, third and fourth metatarsals. The flexor tendons to the index finger and the palmar aponeurosis are superficial to the thenar

space. In the foot, the flexor tendons to the second toe and the plantar aponeurosis are no doubt superficial to the adductor hallucis though to its oblique head. The space between these structures forms a part of M-III only. Thus we see that the spaces corresponding to the thenar and mid-palmar spaces in the hand are not different and distinct in the foot. They are part of the same space M-III.

C. The medial plantar space M-IV is deep to the oblique head of the adductor hallucis where the interossei and metatarsals form its floor. The corresponding space deep to the adductor obliquus in the palm is indistinct.

D. The 'pretendinous mid-palmar space' described by Iselin is bounded superficially by the central part of the palmar aponeurosis with the skin and superficial fascia, and deeply by the flexor tendons and their sheaths, the ulnar bursa. The M-I space is deep to the central part of the plantar aponeurosis with the flexor digitorum brevis and its tendinous divisions, and the tendons of the flexor digitorum longus as its deep relations. Thus M-I corresponds to the 'pretendinous mid-palmar space.'

E. The ulnar bursa contains the tendons of both the flexor digitorum sublimis and profundus. The pretendinous and post tendinous portions of the mid-palmar space are superficial and deep to it. Corresponding in the foot between M-I and M-III lies M-II. The ulnar bursa in its situation can therefore be compared with M-II but with one difference that M-II is a fascial space and the ulnar bursa a tendinous sheath.

F. The medial plantar space deep to the adductor hallucis corresponds to the intermuscular spaces of the thenar eminence of which the adductor pollicis forms a component. Though the medial plantar space is well defined and important in the foot the corresponding ones in the hand are unimportant.

G. The hypothenar area corresponds to the lateral part of the sole of the foot. Deep to the adductor digiti quinti is the lateral

plantar space — corresponding hypothernar space in the palm is unimportant and not distinct.

H. The lumbrical spaces of the foot correspond to those in the hand.

I. The sub-cutaneous and the sub-aponeurotic spaces in the dorsum of the foot correspond to the similar spaces in the hand.

J. The Paronass' space is a retroflexor space. The fascial space in the medial aspect of the leg and ankle in connection with the flexor tendons and muscles is behind them, between them and the bone below. Thus this part of the medial leg space corresponds to the Paronass' space in the forearm and wrist.

## VII. THE ANATOMY OF THE LYMPHATICS OF THE LOWER EXTREMITY

"The *Lymph Vessels* of the lower extremity consist of two sets, superficial and deep and their distribution corresponds closely with the veins.

"The *Superficial Lymphatic Vessels* lie in the superficial fascia and are divisible into two groups; a medial which follows the course of the great saphanous vein; and a lateral which accompanies the small saphanous vein. The vessels of the medial group are larger and more numerous than those of the lateral group and commence on the tibial side and the dorsum of the foot. They ascend in front of and behind the medial malleolus, run up the leg with the great saphanous vein and end in the superficial

sub-inguinal lymph glands. The vessels of the lateral group arise from the outer side of the foot. Some ascend in front of the leg and cross the tibia below the knee to join the lymphatics on the medial side of the thigh. Others pass, behind the lateral malleolus, accompany the small saphanous vein and enter the popliteal lymph glands.

"The *Deep Lymphatic Vessels* are few in number and accompany the deep blood vessels. In the leg they consist of three sets— anterior tibial, posterior tibial, and peroneal which accompany the corresponding blood vessels. They enter the popliteal lymph glands.

"Just as in the hand the superficial lymphatic vessels in the foot all converge to the dorsum of the foot by the shortest route. Those in the plantar surface of the foot over the region of the neck and head of the metatarsals reach the dorsum through the webs of the toes. Thus accompanying any lesions at this region the inflammatory oedema shows itself readily in the dorsum of the foot. In any lesion in the heel or along the margins of the foot, the dorsum of the foot shows lymphatic oedema; where there is a lesion in the outer border of the foot or ankle, the popliteal glands swell up and exhibit signs of regional adenitis whereas in connection with the other areas of the foot and ankle the superficial sub-inguinal glands are involved. If the lesion is deep-seated the popliteal glands invariably show evidences of adenitis."

—(From "Gray's Anatomy")

Figures 2, 4, 6, 8, 10, 11, 12, 13, 14 adapted from Grodinsky's papers.

(To be Concluded)



## SENILE ENLARGEMENT OF THE PROSTATE\*

by S. R. MOOLGAVKAR, F.R.C.S.—Bombay.

The prostate is a male sex gland which surrounds the commencement of the urethra. It is pyramidal in shape and is about an inch and a quarter long, by an inch broad and three quarters of an inch thick. It develops as five lobes, anterior, posterior, two lateral and a middle. (Fig. 1). The anterior lobe disappears during fetal life. The posterior disappears soon after birth.

the urethra anteriorly, a small ridge is seen on the posterior wall surmounted by a depression. The prominence is called the verumontanum and the depression is called the utricle. This latter corresponds to the uterus in the female. On either side of the utricle or just within it are two openings, the opening of the ejaculatory ducts. These ducts traverse the prostate in order to reach these openings. On either side and

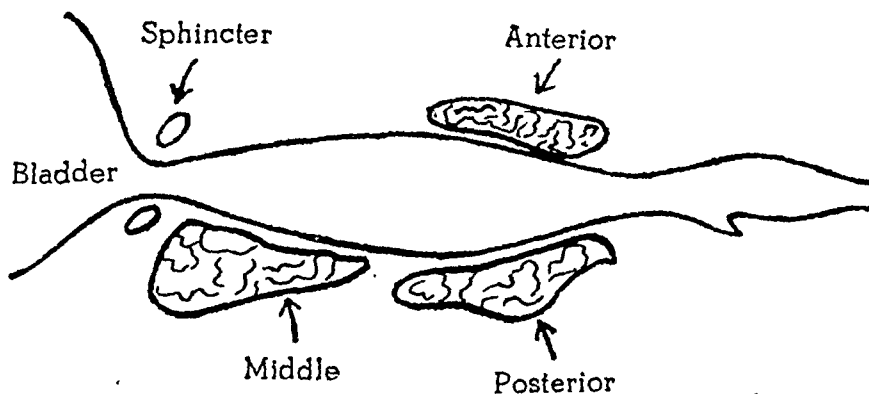


Fig. 1 (After Lowsley)

The middle lobe persists as modified glands behind the verumontanum. The lateral lobes persist and form the two lobes of the normal prostate. These are contained in a capsule. Both lobes are enclosed in a sheath derived from the pelvic fascia. On the deep aspect of the sheath is a rich venous plexus. The apex of the prostate rests against the urogenital diaphragm. The base is applied to the bladder and lies below the internal sphincter. The posterior surface lies in contact with the rectum and is separated from it by a dense fascia—the fascia of Denonvilliers. The anterior surface lies against the cave of Retzius.

The prostatic portion of the urethra traverses the prostate from above downwards and forwards. It lies nearer the posterior than the anterior surface. On laying open

behind the verumontanum are numerous little openings, the openings of the prostatic glands. If a coronal section of the prostate is made, the urethra shows as a transverse slit but in the region of the verumontanum it appears as a demilune with the concavity backwards.

Microscopically the prostate is made up of glands, 20-30 in either lobe and about 15-20 smaller ones behind the verumontanum. These glands are supported by a fibromuscular stroma, the involuntary muscle being very conspicuous.

The function of the prostate is not very obvious though it is quite certain that during the sexual orgasm the involuntary muscular fibres contract vigorously and

\*A paper read in opening a discussion at the 7th annual meeting of the Association of Surgeons of India.

empty out the secretion of the prostatic glands. This secretion is whitish, thin and opalescent. On prostatic massage one can sometimes express small angulated, pale yellowish sago like bodies. These are called *corpora amylacea* and are probably pathological.

The semen as it is stored in the vesicles is lumpy as can be seen immediately after ejaculation and on massage of the vesicles. The prostatic secretion is supposed to liquefy the lumps and liberate the spermatozoa so that they are free to perform their mission. On the other hand there is a view that the prostatic secretion causes clotting of the semen thus preventing the semen running out of the female passages too quickly. I am more inclined to the former view, because in specimens of semen brought soon after emission, for examination in cases of sterility, the semen is found to be quite liquid. The prostate probably has also an internal secretion which increases the sexual urge.

The prostatic urethra is very sensitive. In cases of acute gonorrhoea when the infection spreads from the anterior to the posterior urethra, it is heralded by an increased frequency of micturition. When a bougie is passed into the urethra, the patient feels it most when passing along the prostatic urethra. The sexual ecstasy or libido probably has its origin here.

The act of micturition has not yet been completely and fully explained. It has been held that when the bladder is full, it contracts under volition and the internal and external sphincters being relaxed at the same time are forced open by the increased

intracystic pressure. - This is very simple but unfortunately when we come to apply this explanation to pathological conditions we find that this view is not quite adequate. In enlargement of the prostate the residual urine is a constant sign. When I was a student we were told that residual urine was contained in the post-prostatic pouch, as if the post-prostatic pouch were something like a cigarette tin and not constituted in the greater part by living contractile tissue. Besides, the residual urine does reach amounts which can never be accommodated in the deepest post-prostatic pouch. Of all the explanations so far brought forward, that advanced by Young is the most useful. He draws attention to the fact that there is a triangular sheet of muscle under the trigone of the bladder, attached above to the ureteric orifices and to the interureteric bar, and below to the verumontanum. He further points out that the urethra and the base of the bladder form a slight angle with its concavity backwards. (Fig. 2-A). He maintains that during micturition coincident with the contraction of the musculature of the bladder and loss of tone in the int. sphincter, the trigonal muscle contracts and pulls open the internal meatus. In other words instead of it being just a passive relaxations of the int. sphincter and pressure within the bladder forcing it open passively, the internal meatus is actively pulled open by the trigonal muscle. During cystoscopy it sometimes happens that an irritable bladder goes into a spasm and empties itself by the side of the cystoscope. Under these circumstances if you happen to be observing the base of the bladder you often see the posterior end of the verumontanum drawn

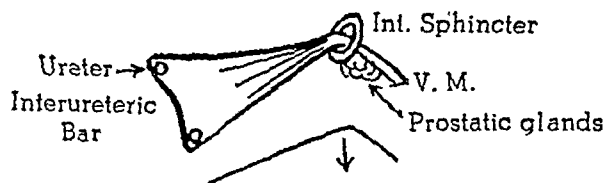
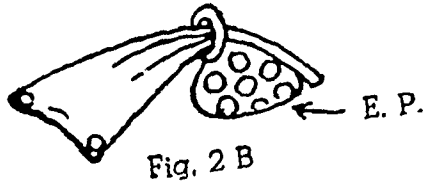
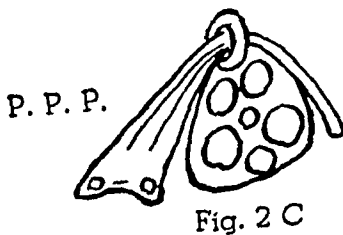


Fig. 2 A ( After Young )

up towards the bladder. I really do not care two hoots how the bladder is emptied but this explanation by Young helps us to understand some of the signs and symptoms of the enlarged prostate. As the prostate gets bigger the internal meatus gets less and less pliant a flow of urine. We have here an explanation of "Hesitation," which is an early symptom of an enlarged prostate. (Fig. 2-B.). It is obvious that if the flow is initiated by pulling open of



the int. sphincter, the flow will be maintained by the continued action of that muscle. In an enlarged prostate, the trigonal muscle has first to overcome the resistance caused by the additional prostatic tissue and then to maintain the internal meatus open. This evidently will require greater effort. Moreover the muscle is in a stretched and therefore weakened condition. As the bladder empties there is a gradual approximation of the two ends of the tri-



gonal muscle, till a point is reached when the muscle can no longer hold open the stiffened int. meatus. It follows that the greater the enlargement, the greater the resistance to the muscle and the sooner the int. meatus will close, even though the bladder may yet contain urine. We have here an explanation of the gradually increasing residual urine. (Fig. 2-C.).

Senile enlargement of the prostate is, as its name testifies, a disease of advanced

age. Regarding its causation we really know nothing definite.

It was suggested that this disease is part of a degenerative process incidental to advanced age, like arteriosclerosis. This view is absolutely untenable because in arteriosclerotic changes fibrosis is the usual change, whereas in the disease under consideration there is enlargement.

Chronic inflammatory changes were supposed by some to lead to enlarged prostate. Here again fibrosis is more likely rather than enlargement. One of my old teachers used to assert that enlarged prostate is very unlikely in men who have suffered from a stricture of the urethra. I must say I have not yet come across a case where these two diseases were coincident. I should like to know whether my colleagues here have a similar experience.

Enlargement of the prostate occurs at an age when the sexual powers are diminishing. The prostate is a sexual gland and the gland enlarges probably as a result of a diminished sexual internal secretion at an advanced age. Castration at an early age on the other hand leads to decrease in size of the prostate glands. Injection of testicular extract restores them to an apparently normal condition.

Formerly this disease used to be called "Hypertrophy of the prostate." This is evidently a misnomer as the enlargement is not of the nature of a hypertrophy, wherein all the tissues participate, but is more an adenomatous change. If at all, it corresponds more to the chronic mastitis seen at the menopause or to a goitre due to deficiency of Iodine. It is quite true that we do not definitely know what exactly causes the adenomatous change in the prostate. Looking in reverse we can say that it is lack of testicular secretion because we find that there is some relief of symptoms on injection of testicular hormone which is derived, according to some, from the interstitial cells of Sertoli and, according to others, from spermatogonia. Before the days of hormone therapy, vasectomy was

done to relieve this condition without exactly knowing why it did so. From the days of Steinach we know that vasectomy leads to a temporary increase of internal testicular secretion. Diminution of testicular secretion alone could not be the sole cause because if that were so, injections of the testicular hormone should cure this condition, but we find that this is not so. There must, therefore, be something more involved in the genesis of this condition. For some time now I have had an idea recurring in my mind and this was particularly after one had often noticed the marvellous improvement in many cases of cancer of the prostate after injections of Stilbcestrol, together with moderate improvement that follows the injection of testicular hormone in senile enlargement. The idea is that in the human male both these hormones exist and that they are correctly balanced by some factor, which we do not definitely know. When the male hormone diminishes there is senile enlargement and when the female hormone falls short there is cancer. By supplementing the hormones we can produce improvement but because we cannot affect the controlling factor the benefits are not curative.

As the prostate enlarges, the lateral lobes participate most. The middle lobe enlarges only in a small number of cases. During enlargement the sheath is put under tension, but yields gradually to the increased tension within; the tension within, however, never completely disappears. The apex of the prostate is resting against the urogenital diaphragm, a tough structure which does not allow any enlargement to proceed in that direction. The base is applied to the bladder and in this direction enlargement can occur more freely. The prostate therefore can enlarge in a longitudinal direction more freely and we find that this is so. The urethra being enclosed within and attached to the prostate participates in this increase in length. Freyer has recorded an increase of six inches in the length of the urethra basing this on requiring a 16" introduction of the catheter before reaching the bladder. The longest I

have come across is 14" and here I could feel the prostate quite an inch above the symphysis pubis. The urethra being attached to the prostate, as the prostate enlarges, the urethra also increases in the antero-posterior diameter. Apart from the lengthening and widening of the urethra an angulation also takes place with the concavity of the angle directed forward. This angulation is due to the holding down of the urethra by the ejaculatory ducts, the apex of the angle being at this point. This angulation is sometimes further enhanced when the glands behind the verumontanum, which resemble but are not identical with the prostatic glands, also, participate in the enlargement and form a true middle lobe enlargement. Freyer never admitted the existence of a separate middle lobe enlargement. He maintained that the projection in the bladder was caused by the undue projection of one or the other lateral lobe. Such mediolateral enlargements are often found but there is no doubt that a genuine middle lobe enlargement does occur. Some people explain interruption of the flow of urine in prostatics as caused by the ball-valve action of such a middle lobe. For this to occur the middle lobe enlargement must be freely movable as if on a hinge or on a spring. This is never so. The interruption probably has the same explanation as that occurring with a stone in the bladder, namely, spasm of the int. sphincter. It can quite easily be understood that when angulation is markedly present the passage of an ordinary catheter will be impeded. The coude catheter is very useful here. Even this does not suffice sometimes. In such cases a Harrison stylet threaded into the catheter—always taking care to see that the point of the stylet will not come out of the eye of the catheter, otherwise the urethra will be ploughed up—and then moulded to the necessary curve, is always useful. Sometimes even this is not sufficient and then a finger introduced in the rectum lifting the catheter over the obstruction usually allows the passage of the catheter. There are indeed very few cases which will not yield to this manoeuvre. I am not fond of using metal catheters. If all

these means fail, the only way is either suprapubic puncture or a decompression operation.

While we are on the subject of the middle lobe I may mention that Freyer described what he called a preprostatic pouch, namely the space in front of the middle lobe constituted by the prostatic urethra. He diagnosed it when on introducing a catheter only a small quantity—about an ounce or two—of urine was withdrawn even though the bladder was felt distended above the symphysis, but if after the initial flow ceased the catheter was pushed further in, a large quantity of urine was withdrawn and the bladder emptied. He also claimed to have crushed stones in this situation. I have no experience of this pouch.

Apart from the elongation and angulation, the urethra is compressed laterally by the tension within the sheath of the prostate. Whereas normally the coronal section shows the prostatic urethra as a transverse slit, in enlarged prostate the slit becomes antero-posterior. An unequal enlargement of the two lobes leads to a sinuous or tortuous urethra, with corresponding difficulty in the passage of a catheter.

During enlargement of the prostate there must be increased blood supply; this will be reflected in the urethra as congestion. We find therefore that one of the earliest symptom a patient with enlarged prostate suffers from is burning during micturition. An elderly person without a urethral discharge complaining of burning during micturition should always make us think of an enlarged prostate.

There is usually a congestion of the pelvic viscera in the early hours of the morning as is evidenced by an early morning erection. This congestion superadded to the existing congestion in an enlarging prostate leads to the characteristic early morning frequency of micturition.

In some cases, the increased vascularity together with some personal anatomical anomaly in the patient leading to venous

obstruction, results in the formation of varices. These are most manifest in the least supported part of the prostate, i.e. the internal meatus and the vesical surface. These varices sometimes burst and lead to quite a tidy haemorrhage. It is a noteworthy fact that bleeding is more common with a simple enlargement than with a malignant one.

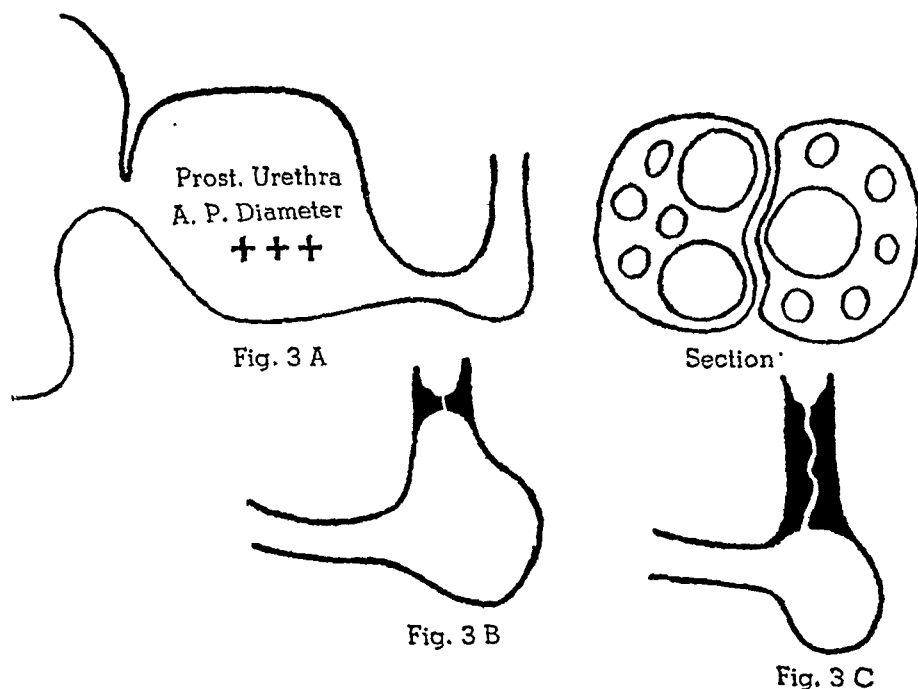
Another important result of congestion—I should rather say an attack of congestion, the result of a chill or of some indiscretion in diet or sexual life—is retention of urine. A passage which was already partially obstructed as a result of tension within the sheath gets completely obstructed as a result of increased tension due to the attack of congestion. This is one of the symptoms which definitely makes the patient seek help. That the attack of congestion plays an important part in retention there is no doubt because the congestion passes off after a few days and the patient returns to the *status quo ante* retention. I must say here that some observers attribute retention to neuro-muscular action, in other words spasm. I am not inclined to agree with this.

We have already seen the mechanism of residual urine. The residual urine gradually increases and with it also increases the frequency of micturition. The bladder being incompletely emptied gets full enough to excite the micturition reflex sooner and sooner. But it is not all so simple as the example given in most text-books namely that—suppose the capacity of the bladder is 10 ozs., a person to void the normal quantity of urine must micturate five times. Suppose that there is 4 oz. of residual urine, the available capacity is only six ounces and therefore the patient must pass urine 8 times. This is alright as an example but we must not forget that as the residual urine increases the bladder gets stretched and holds more and more urine. This is particularly so when the residual urine approaches and passes the normal capacity of the bladder. Residual urine may reach quite large quantities and yet the patient may not be conscious of it. I have seen distended

bladders the result of residual urine reach up to the umbilicus and yet the patient was not conscious of it beyond a feeling of heaviness and of the abdomen getting bigger. During retention due to enlarged prostate I have seen the bladder reaching between the umbilicus and the xiphisternum. Another notable feature is that with retention, the prostatic does not suffer the same agony that a man with retention due to stricture suffers with a much smaller distended bladder. This is probably due to the bladder having been gradually stretched out in a prostatic as compared with the acute distention and stretching in a stricture. As a result of the constant distention and of repeated efforts at emptying the bladder the longitudinal fibres of the bladder get hypertrophied and

straining forces them together and tends to interrupt the flow. Swift Joly built a hydrostatic theory round this fact. Such prostatics do not strain during micturition. As a result of frequent straining by elderly persons, direct and when there are pre-formed sacs, indirect, herniae occur. Pro-lapse of the rectum and bleeding piles are another result of the same.

The stream of water in a prostatic is usually quite big in contrast to that in a stricture of the urethra. The force and projection however suffer. In the prostatic the main difficulty is in getting the internal meatus open. Once that is open the passage is potentially wide, though by the pressure of the enlarged lobes it is reduced to a mere chink. If the meatus is well opened a fair quantity of urine can flow through but the



stand out as trabeculae, with recesses between—sometimes of fair size—which are called sacculi.

A prostatic strains during micturition. It sometimes happens that the anatomical configuration of the two lobes is such that

force of the flow is reduced because it is expended in keeping the chink open (Fig. 3-A). In the case of the usual type of annular or diaphragm stricture (Fig. 3-B) however the opening is inflexible and the flow through is comparatively small and

therefore the stream is small, but the force is not diminished to any extent because practically no pressure is expended in keeping the narrowed part open. In cases of tortuous strictures (Fig. 3-C) however, both flow and force are diminished. This occurs also in prostatitis when there is considerable pressure within the prostatic sheath as in cases approaching retention.

In marked cases of prostatic obstruction, a largish flow falls straight down from the external meatus. There is often interruption and there is dribbling at the end. In many cases the patient passes a quantity of urine with much straining but does not feel quite satisfied. He tries five or ten minutes afterwards and can pass a fair quantity without much difficulty. Here probably there was marked congestion which caused the initial difficulty but after a portion of the urine had been passed, the congestion diminished a little and the flow was more easy.

As the quantity of residual urine increases and approaches the normal capacity of the bladder, back pressure begins to be felt by the ureters and kidneys. These dilate bilaterally but never to any great extent. The most important effect on the kidneys of the back pressure is interstitial nephritis which gradually cripples the kidneys leading to retention of waste products in the blood and to chronic uraemia.

Infection after instrumentation is quite easy in prostatitis. Once infection occurs it gets worse rapidly and is difficult to eradicate because the bladder is never completely empty and the residual urine acts like a seeding medium. Infection superadded to back pressure leads to septic pyelo-nephritis and to rapid destruction of kidney tissues and function.

The main symptoms and signs of enlarged prostate therefore are burning during micturition, hesitation, frequency particularly in the early morning, difficulty in micturition, loss of force in the stream, retention of urine and chronic uraemia. To this, signs of septic pyelonephritis may be added.

Harassment by frequent micturition during the day, exhaustion by disturbed sleep by repeated micturition during the night, suffering and anxiety resulting from retention and interstitial nephritis lower the body resistance and make the patient an easy prey to intercurrent disease like pneumonia; septic pyelonephritis often gives the *Coupe de grace*.

When an elderly person comes to us complaining either of burning during micturition or frequency or difficulty we naturally think of an enlarged prostate.

On inquiring into the history, we find that the trouble started insiduously and has progressed gradually. The history most often extends over a year or two. Sometimes it extends over 4-5 years and I had a case which gave a history extending over nearly 20 years. Many of the patients are not observant and take notice only when there is difficulty in micturition. A few wake up only when there is retention. Rarely the first sign is haemorrhage. Most of my cases came during the difficulty period and many only after retention.

The usual questions regarding micturition namely frequency D/N, force, stream, hesitation, interruption, haematuria, passage of gravel and retention are asked. The condition of the tongue is noted.

The abdomen is examined by inspection, palpation and percussion particularly as to the condition of the kidneys and bladder. In prostatitis a distended bladder is not an unusual finding without the patient being aware of its existence. The patient should be made to pass urine in your presence to verify some of the answers to the questions asked regarding micturition.

A rectal examination of the prostate is best made with an empty or nearly empty bladder. It is also necessary in cases of enlarged prostate to determine the quantity of the residual urine. Passing a catheter into the bladder opens the gateway to urinary infection. This is much more so in a prostatic. Special precautions should therefore be taken. The foreskin when present should be completely retracted and the

perputial sac well washed. It is surprising how often smegma is allowed to accumulate even in otherwise clean persons. The meatus should be well opened and washed out with a stream of antiseptic solution. Nowadays I use Dettol 1-150 for this purpose. It is needless to say that the surgeon has washed his hands clean. A sterile No. 10-12 catheter is now taken. The lubricant I use is a mixture of vaseline and liquid paraffin of the consistency of honey. This mixture is autoclaved and kept in a glass-stoppered bottle. In order to economise a small quantity is floated on to a quantity of sterile water in a minim glass. The catheter is now dipped into the lubricant and then gently inserted into the urethra and passed into the bladder. The difficulties in connection with this have already been discussed. The urine collected is measured. It must be noted however that in a suspected prostatic whenever there is distention of the bladder unrelieved by micturition, with the bladder extending more than an inch above the symphysis, the bladder should not be emptied completely at once. Under these circumstances the patient should be admitted into a hospital or nursing home and after passing a catheter a stopcock should be fitted to the catheter as soon as it enters the bladder. The catheter is then tied-in. The stopcock is next opened so as to allow the urine to escape drop by drop. It is no use measuring this urine with the idea of determining the residual urine, as the urine is being added to continually by more coming down the ureters. It can obviously be taken for granted that the residual urine is considerable. The object in not emptying the bladder at once under these circumstances is to prevent haemorrhage from the kidneys. The urine which has been dammed up and has been exerting back pressure, when suddenly let out, induces haemorrhage by the sudden withdrawal of the support afforded during months and sometimes years of back pressure. The haemorrhage in itself is not very serious but in advanced cases where naturally the bleeding is more marked, the blood clots within the tubules of the kidney and leads to anuria, uremia and death. Before withdrawal of the catheter

it is my invariable practice to wash out the bladder with Pot. Permanganate 1/2000 when the urine is cloudy and in all cases to instill 10 c.c. of 1 per cent. aqueous acriflavine. Whenever a catheter is tied in, the bladder is washed out daily. In all cases of instrumentation an urinary antiseptic is given, before whenever possible, and always after. I usually prescribe Hexamine grs. vii three times daily.

Once the bladder is empty a rectal examination of the prostate is made. I use the dorsal position with the legs well drawn up and separated. This allows the pulp of the examining finger to come in contact with the prostate comfortably. The finger should be well lubricated. The median groove is noted; then the lateral lobes, their size and consistency. The upper border of the prostate is next defined. Then with the left hand pressing in above the symphysis pubis a bimanual examination is made to determine the mobility of the prostate. The last two points cannot be made out properly if the bladder is distended.

The senile enlarged prostate is usually uniformly enlarged on both sides. The lobes feel elastic and are movable. They are not tender to the touch.

An acutely inflamed prostate may give rise to difficulty in micturition and even to retention but it is a disease more common in younger people, is of acute onset, accompanied by fever and by pain in perineum and rectum. The prostate is enlarged and is acutely tender.

Fibrosis of the prostate occurs often in old people and gives rise to difficulty in micturition and even to retention. It is usually accompanied by arteriosclerosis. The prostate is smaller than normal and is hardish to the feel. It is not so mobile as a normal prostate.

Prostatic calculus may give rise to moderate unilateral enlargement but usually there is no definite increase in size. There is a hardish nodule to be felt in the prostate which is slightly tender to the touch. There is usually some burning during micturition. The X Rays clinch the diagnosis.



Carcinoma of the prostate occurs about the same age as the senile enlargement. It is more rapidly progressive. The prostate shows a hardish nodule, not tender to the touch. The prostatic lobe involved is firmer. The X-Rays show no shadow. In the early stages the mobility is not affected but in the later stages the prostate tends to be fixed and nodular all over.

Cases sometimes come up with difficulty of micturition with residual urine or even with retention and in whom no enlargement of the prostate can be made out. These are cases of nervous diseases particularly tabes. It is best to make an invariable rule to test the knee jerks and do a Rhombberg in all cases of dysuria and retention.

I do not use the cystoscope as a routine in cases of enlarged prostate. I do however use it when the urine contains pus or blood, in order to determine the source of these. When cystoscopy is necessary I do it with the patient lying down with the legs extended and slightly separated. I put a four inch sandbag under the sacrum. The medium used is sterile water. First the bladder is examined. Trabeculae and sacculi, if any are noted. The trabeculae in an enlarged prostate are coarse and short. Those found in a paralytic bladder are fine and long. Stones if any are noted. In cases with septic urine diverticula are looked for. The ureteric orifices are next located and the efflux watched to see whether it is normal, turbid or bloody. The ureters are sometimes difficult to locate being almost vertically below the internal meatus at the bottom of the post prostatic pouch. In cases of haematuria the area round the vesical orifice is carefully examined for varices. The cystoscope is next withdrawn so that the observation window is half in and half out of the internal meatus. The normal picture in this position as the instrument is slowly rotated is of a smooth concavity all round. The most characteristic finding of an enlarged prostate is an inverted V anteriority. This is due to the bulging lateral lobes. The lateral walls also often show bulges. Dilated veins are also sometimes seen.

Having established the diagnosis our next step is to lay out the line of treatment. The enlarged prostate is a mechanical obstruction and the only logical and certain method of treatment is the removal of the prostate. All other means are palliative.

Before we undertake an operation for removal of the prostate we must have certain data on which will depend whether we remove it in one stage, in two stages or postpone or abandon the idea of an operation.

Firstly regarding general condition: Very fat or flabby men or men with short necks are bad risks. Men with persistent cough from any cause and men with weak hearts should not be interfered with radically till their condition is remedied and improved. Men with a dry tongue, headache and other signs of chronic uremia must be prepared carefully and brought up to scratch if possible by preliminary treatment.

A routine blood examination must be made, anaemia if present must be dealt with. Blood coagulation time should be noted and if necessary treated. I nearly lost a case once because of lack of this precaution. Urea clearance test should be done. Below 40 per cent operative interference is not justified, between 40 per cent and 60 per cent a two stage operation should be considered and above 60 per cent a one stage operation may be undertaken provided other factors are favourable.

Pus in the urine should be got rid of if possible and always demands a two stage operation if it comes up to prostatectomy. Diverticula of the bladder if present should be dealt with in the first stage of the operation. These diverticula are found most often near the ureters or at the fundus near the attachment of the urachus. Before we consider the operation itself I should like to say a few words regarding the history of the operation.

In the old days during a median and lateral lithotomy, portions of the prostate which came in the way were often removed by lithotomists. Most often such pieces

were the enlarged middle lobe. Later when suprapubic lithotomy began to be performed similar projections into the bladder were come across and were removed. The first record of this is by Amussat in 1827. It was not till about 1885 that this procedure was deliberately advocated and carried out by Dittel. Belfield in America did a similar operation in 1886. These were all partial operations and their benefit was also partial and temporary.

It is claimed that Fuller in America did the first complete suprapubic prostatectomy in 1894. Freyer in England did his first suprapubic prostatectomy in 1899. During the first decade of this century there was a bitter controversy as to who should be called the father of this operation. There is no doubt Freyer reaped a rich harvest of prostates in England and by publishing his results made the world familiar with the operation.

It is said that at a well-known Conservative club in London, where prostatics foregathered of an evening, the suffering prostatics gaped with wonder and envy while a prostatectomised colleague passed urine freely. Naturally there could have been no better advertisement. Anyhow suprapubic prostatectomy was recognised and came to stay.

Meanwhile, following the lithotomists came another school for removing the prostate, via, the perineum, and there was a wordy battle over the advantages and disadvantages of the two types of operation.

To me it seems that it is a waste of effort and skill to remove a prostate via, the perineum when you can so easily and simply do it by the more direct suprapubic route. It does not require any very special appliances or instruments either.

In preparing a case for the suprapubic operation, the patient is shaved from the epigastrium to the knees and that much area of skin is prepared in the usual way. The patient is also prepared generally as for an abdominal operation. I practically always use spinal anaesthesia using about  $1\frac{1}{2}$  to  $1\frac{3}{4}$  grains of novocain dissolved in

about 6-7 c.c. of the patient's cerebro-spinal fluid.

A catheter is next introduced and the bladder is washed out clean with boracic solution 3 per cent. The bladder is then distended by 8-12 ounces of the lotion or till it can be felt tense above the symphysis. A full syringe is then attached to the catheter. It sometimes happens that the fluid escapes round the catheter. In such cases a strip of gauze is tied round the penis to help retain the fluid.

An incision about 3-4 inches long is made in the middle line from the pubis up. After separating the recti and pyramidales the bladder with the prevesical fascia and fat is exposed. The fascia should be incised transversely for about 2 inches just above the pubis. Then with the fingers and with gauze, assisted by snips of scissors here and there, the fascia and fat should be pushed well up for at least three inches. With this goes the peritoneal reflection. The bladder proper is now seen with its muscular fibres and veins. By means of Allis' or tissue forceps the bladder is picked up a little on either side of the middle line, about one and a half inches above the pubis. With a knife a small incision is made into the bladder and immediately plugged with the finger. If a suction apparatus is available the fluid from the bladder is sucked out after withdrawing the finger. If not the syringe is disconnected from the catheter and the fluid allowed to run into a kidney tray.

When the bladder is empty the incision is extended to two inches but care should be taken that the incision does not approach nearer than  $\frac{3}{4}$ " above the symphysis. I have found that incisions extending to or below the upper margin of the pubis are a fruitful source of a troublesome fistula afterwards. If during further manipulations the bladder gets torn downwards it should always be stitched up so that the opening left is three quarters to one inch above the pubis. After opening the bladder the Allis' or tissue forceps should be shifted so as to grasp the whole thickness of either lip of the bladder wound. A finger is now introduced in the bladder and stones if any are scooped out.

The prostate is felt from the vesical side. Sometimes it projects markedly, at other times it is just a firm bulge.

In cases where permanent cystotomy is intended and in those cases where a two stage operation is to be done this is the end of the interference for the time being except that if there are any diverticula these are dealt with now. A three quarter inch inside diameter rubber tube is introduced and the bladder wound approximated round it. The tube should have two lateral holes at the bottom and the bottom edge should be chamfered. The tube should not be long enough to touch the base of the bladder as this excites spasmodic contractions on slight movement by the patient and is unnecessary suffering. A gauze drain should be put in the cave of Retzius and the rectus sheath brought together by interrupted catgut. The subcutaneous fat and skin are approximated by interrupted silkworm gut stitches. The tube should be anchored by a stitch which should divide its lumen one third and two thirds and is then cut off half an inch above the skin. A few pieces of gauze and copious cotton wool or if obtainable cellulose dressing should be applied and retained by a four tailed bandage. The after care is the same as after a prostatectomy and will be considered there.

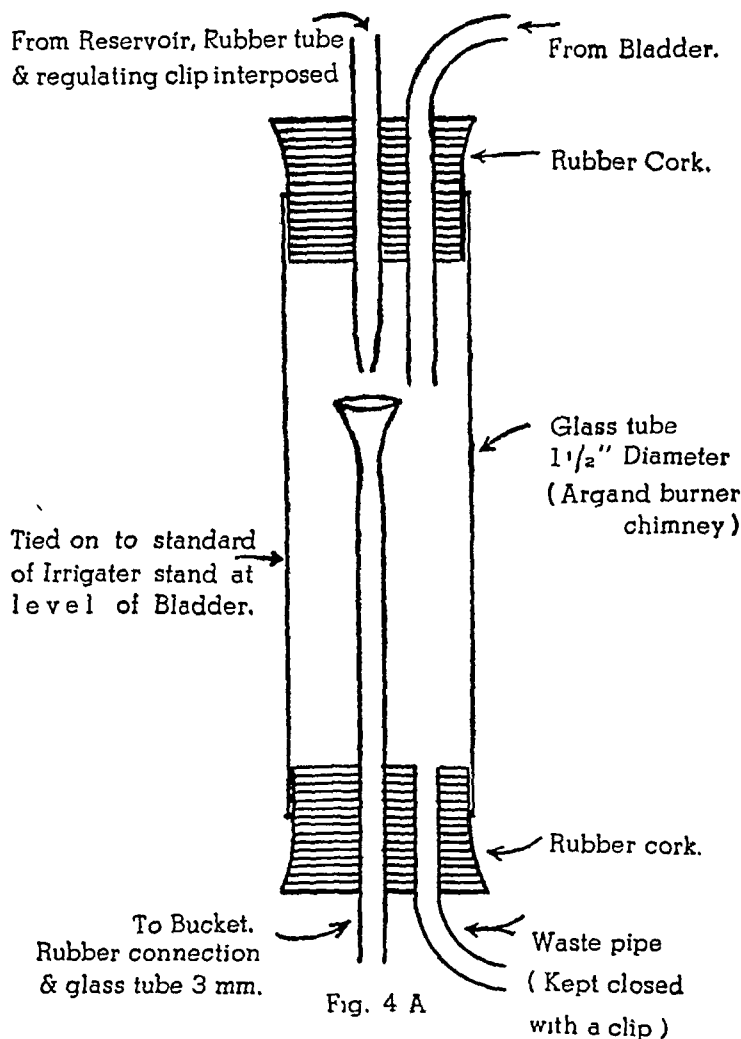
The second stage of the prostatectomy should be undertaken within two or at most three weeks after the first stage. If longer time is allowed to elapse the abdominal wall in the region of the cystotomy becomes unyielding and it becomes difficult to depress it sufficiently to ensure easy enucleation of the prostate.

After the usual preliminary preparation, the tube is removed and the bladder washed out well. Incisions in the skin are made to enclose the scar of the first operation. The rectus sheath is opened up and the bladder exposed. Great care is necessary in pushing up the peritoneum as the tissues are now more adherent and more friable. After enlarging the opening in the bladder a sterile towel is laid like a gutter over and between the separated thighs and the gloved

index and middle fingers of the left hand well lubricated are passed into the rectum and by pushing upwards and forwards steady the prostate. The ungloved right index finger is passed into the bladder and the internal meatus is felt. The catheter which is in the urethra should be withdrawn so that it just projects into the bladder. Too much of it in the bladder comes in the way. The tip of the finger is pressed hard against the superior surface of the right lobe of the prostate a good half inch away from the meatus. I have found no necessity to use either scissors or keeping a long nail on my finger. The mucous membrane is felt to give way under the strain and the finger gets on to the prostate. The direction of the pressure is slightly changed from parallel to the urethral axis to slightly outwards. The finger, if in the proper plane passes comparatively easily and is pushed on the lateral aspect of the lobe towards its lower pole. The finger is then withdrawn more than half way and swept anteriorly and posteriorly along the outer aspect of the lobe. This tears the mucous membrane in a semi-circle around the internal meatus. The same sweeps are repeated in stages right down to the lower end until the right lobe is free laterally, anteriorly and posteriorly. The catheter in the urethra helps to locate the apex though its presence is not absolutely necessary. The finger is now swept over to the left side and if the proper plane has been entered there is no difficulty about this. If however after an attempt or two the finger cannot be switched over, a fresh start should be made over the base of the left lobe and all the manoeuvres repeated till the left lobe also is free. When both the lobes are free the index and middle fingers are placed on either side of the urethra at the apex and the whole prostate forcibly pulled up towards the bladder; this ruptures through the urethra and delivers the prostate into the bladder. All this time the fingers in the rectum have been co-operating with the finger in the bladder steadying and pushing as required. Both hands are now withdrawn. The glove on the left hand is removed after being covered with a small

towel. Both hands are rinsed with Dettol and spirit equal parts, dried, dusted and fresh gloves put on. The prostate is now seized by the prostatic forceps and delivered out of the wound. With large prostates this may be difficult and the prostate may have to be delivered lobe by lobe. Occasionally with a small prostate, it slides about in the vesical cavity and causes exasperation.

bleeding practically ceased. Sometimes however the bleeding persists and blood wells out of the wound. The catheter which is still in the urethra is adjusted so that the eye is in the prostatic cavity and is then connected to an irrigator containing 1/2000 silver nitrate in distilled water at about 115°F. About two pints of this fluid are run through keeping the irrigator about one



There has been a certain amount of bleeding during the operation but ordinarily by the time the prostate is delivered outside, the blood has clotted well and the

foot above the pubes. Care should be taken to see that there is free exit for the blood clots and the fluid through the abdominal wound, if not there is distention of the pros-

tatic cavity and more bleeding. At the end of the irrigation the bleeding has ceased in practically all cases. In those very few cases where the bleeding still persists either a Pilcher bag is introduced or the prostatic cavity is plugged with gauze. I used to do the former but nowadays the bags are not available and besides the removal of the bag afterwards is always a painful procedure. Therefore I pack when necessary. The

pleted as for a suprapubic cystotomy, the gauze drain in the space of Retzius not being omitted. A quarter grain of Morphia is injected before the patient is sent back to the wards.

Some patients suffer from shock for which lowering of the head is usually sufficient. If not intravenous plasma meets the needs,

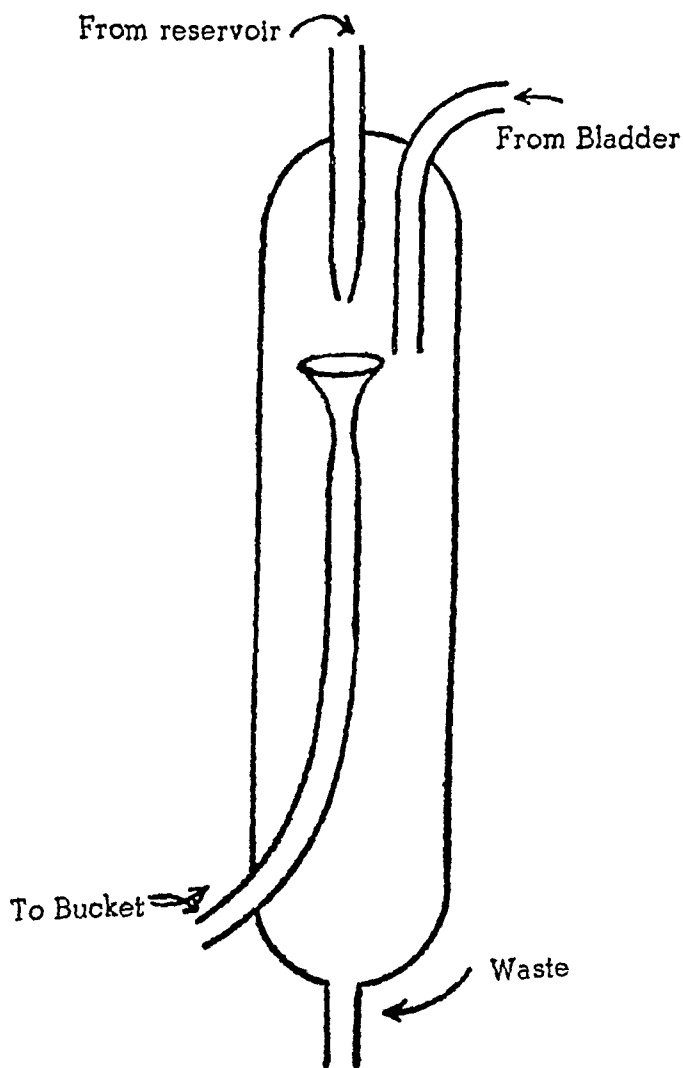


Fig. 4 B

gauze I used to soak in vaseline but now I sprinkle sulphanilamide powder and pack it in. The gauze roll should be about one inch broad by  $\frac{1}{8}$  inch thick. This means about six layers. The operation is now com-

In a few hours the dressings are soaked in blood-stained fluid. So long as the fluid is only bloodstained I do not worry but if clots begin to accumulate, in unpacked cases, over the abdominal wounds I certainly

worry. It means taking the patient down to the operation room, removing the tube and a few stitches and packing the prostatic cavity under anaesthesia. The tube and stitches are replaced afterwards. In moderate bleeding Cal. Gluconate intravenously, Coagulen Ciba, elevation of the foot of the bed, etc., are tried. It is no use wasting time with these if the bleeding is serious and the pulse going up.

After about six hours I put the patient on suction drainage. If dressings only are used they get soaked in no time and the urine gravitates to the sides and wets the bed-sheets and makes the patient very uncomfortable. When I was a House Surgeon at St. Peter's, London, one of the surgeons used to have cellulose dressings only. The patients were very uncomfortable. The other surgeons used to use the Irving's box. This kept the patient reasonably dry provided he did not move much. The disadvantage was that unless properly adjusted it pressed on the wound and was uncomfortable and even painful. It also tended to cause oedema of the wound and delay in healing. For some years now I have been using a simple suction apparatus. It keeps the patient quite dry. He cannot however turn on his side. Herewith is the illustration of the main part namely the pump. The most important part is the central funnel. It helps to form the interrupted column of water which by an action similar to Sprengel's pump keeps the suction going. If a sample of the urine, unmixed with water is required, all that is necessary is to connect a Wolf's bottle between the bladder and the pump. The bladder is irrigated out daily through the tube as well as through a catheter introduced into the prostatic cavity. This latter step is absolutely necessary in cases where sepsis is present. In very bad cases of sepsis I use an automatic irrigator together with the suction, the catheter being kept in the prostatic cavity. In ordinary cases the irrigation is done twice a day. For irrigation I use one volume Hydrogen Peroxide or if that is not available Pot. Permanganate 1/2000.

On the 4th to 6th day I substitute a smaller tube. On the 12th to 14th day the

tube can be dispensed with. I tie in a catheter when I remove the tube. The catheter can be dispensed with in from 5-7 days. All these dates depend on the progress of the wound and of sepsis if present.

In cases of permanent suprapubic cystotomies a self retaining catheter is put in about the 7th day.

The patient is asked to pass urine every two hours or so after the catheter is removed. There is ordinarily no difficulty and there is no leakage from the suprapubic wound. Sometimes a fistula persists and in such cases the catheter is tied in again and the fistula cauterised with silver nitrate fused on to a probe. This usually suffices, but if it does not, scraping with a small spoon should be done. Fistula sometimes persist in spite of all this and here either the bladder has got adherent to the pubis or there is persistent marked sepsis or there is obstruction at the internal meatus. For the first condition opening up the suprapubic wound and liberating the bladder and cutting away as much of the fibrous tissue as possible is necessary. It is because of this that emphasis was laid on having the bladder wound at least three quarters of an inch above the pubis. The second condition is likely to arise from an overlooked diverticulum or from bad cystitis or pyelonephritis. With a catheter tied in they heal, but are apt to break down again and again. Getting the patient up and about sometimes helps in these cases. The last condition is diagnosed by passing a bougie. A mere narrowing is dilated by bougies and MacCarthy's resectotome is used to remove sections of the narrowed opening. In the very rare complete obliteration of the internal meatus a suprapubic approach and a bougie in the urethra—in fact a retrograde catheterization operation for impassable stricture in reverse—is necessary. This condition arises because enucleation is started too close to the internal meatus. It should be started at least half an inch away. It is possible that a fistula may persist because of incomplete removal of the prostatic adenomas.

Amongst all the operations performed for enlarged prostate by me it has been my misfortune to have had three cases of sudden

death, the result apparently of sudden cardiac failure. One was in a two stage case very soon after the patient was discharged. The second was in a case of suprapubic cystotomy in which the patient was not suitable for prostatectomy and the third was in a single stage operation on the seventh day. All these cases were apparently doing well but were dead within a few minutes of the seizure. I do not know what the 1st was doing but the second was sitting up in bed as he was wont to do and the third had just got on to a bedpan. These deaths were a great shock to me and I should like to know if any of my colleagues here have suffered from similar misfortunes.

Amongst later complications hernia of the scar has occurred in five cases. In two the hernia was fair sized. The large tube used probably has something to do with this.

Stones have formed in two cases. There was a history of previous stone formation in one. Both were probably helped by mild sepsis. One was two years and the other four years after operation. The stones were crushed and removed.

The non-operative treatment consisted in the old days in inducing a catheter life. This was before the firm establishment of prostatectomy. The patient was taught to pass the catheter himself. I have seen such patients when I was a House Surgeon at St. Peter's in 1914-15. Considering everything it was miraculous that the patient did not develop cystitis more often.

Cases with retention which are not suitable for the radical operation and which do not respond to the other palliative measures immediately to be described should be recommended to have a permanent suprapubic cystotomy done.

The catheter however has a place in the treatment of enlarged prostate. In case of large residual urines and in cases who come to you with retention, it is best to tie in a catheter. I have here a few models to show the method of tying in a catheter used at St. Peter's. Of all the methods I have

seen it is the best. I always have two holes instead of the usual one in the catheter. One can easily cut a hole on the side opposite to the existing one. If one hole gets blocked by a fold of mucous membrane or by mucopus, the other is there. Before tying the tape the best position is found by withdrawing and pushing in the catheter. The aim is not to get a sudden gush but to get a steady constant drip. When this is found the first tape is tied just beyond the external meatus. The remaining stages are illustrated in the models. The bladder should be irrigated with Pot. Permanganate 1/2000 at least once a day and some urinary antiseptic should be administered. It is surprising how very often the general and urinary condition and the blood picture of the patient improve within a fortnight of tying in the catheter. The catheter should be changed every four days if of gum elastic and a new one put in. In the case of rubber catheters it suffices if they are changed once a week. They can be boiled and used again provided they retain sufficient stiffness.

One of the methods of treatment used was massage of the prostate. Steady but not too vigorous strokes are used. The massage is done twice a week. The rationale is the emptying out of the cystic spaces in the adenomas. The result is to ease micturition. The effect is very temporary and is usable in the earlier stages of enlargement. It can hardly be called treatment.

Whenever some new form of treatment comes in there are always enthusiasts amongst us who will try it out and sometimes convince themselves and often try to convince others that "This is it". When medical electricity came in, galvanic and faradic currents with special electrodes for the prostate were tried out for chronic gonorrhoeal prostatitis. It was also tried for enlarged prostate, needless to say, without any benefit beyond a psychological effect. When diathermy came in, this horse also was run for all it was worth. The fomentation relieved congestion at times with transient beneficial effects. Short wave therapy cannot claim anything better.

Amongst what I may call the mechanical electrical appliances, Bottini, as far back as 1876, invented his prostatic galvano-cautery. This instrument, contained a platinum blade capable of being heated like an ordinary galvano-cautery. This blade could be made to traverse the prostate by means of a screw something like the lithotrite screw. Linear cauterisation of the prostate was carried out. After some days a slough of the burnt tissues was passed out and there was a little relief of symptoms. The gap however soon filled up and the symptoms returned in full. At best it was a blind operation and sometimes lead to bleeding and other accidents. For more than 25 years it had a vogue as is testified by the numerous modifications of the instrument invented, among others, by Young.

The most recent electro-mechanical appliance is MacCarthy's trans-urethral resectotome. The instrument is provided with a telescope and is electrically lighted so that you can see what you are doing. There is also a circulating water medium provided, so that the field is kept clear except in case of much bleeding. The resectotome part is a small loop through which a high frequency cutting current can be passed. This loop together with the light and telescope can be moved through about two inches by means of a rack and pinion outside. By this instrument slivers of the prostate  $1/8''$  to  $1/6''$  thick and about two inches long can be removed. Coagulation current can be superimposed at the same time so that bleeding is reduced to a minimum. I have tried out this instrument in enlarged prostates. The first half a dozen cuts or so are alright but as you go deeper a small vessel starts spouting, in spite of using heavy coagulation current, and no amount of water circulation is capable of keeping the field clear. The seance has got to close. Sitzings can be given at weekly intervals. The instrument is a fair-sized one approaching No. 30 F. The patient must have anaesthesia. Rather than give repeated anaesthesias I would do a prostatectomy in one go. Besides it would not be possible to remove the prostate with this instrument

completely. We cannot therefore classify this method as curative. I have however found it valuable in the shrunken fibrous prostate causing difficulty in micturition. Here a few slices removed from the internal meatus has always given relief. Prostatectomy in these cases of fibrous prostate is an undertaking—I have put in as much as an hour and a half's-strenuous work taking out a prostate an inch by three quarters. It is not worth it. I have used the resectotome since; it is simpler.

Amongst electrical remedies, X-Rays certainly deserve notice. Those cases which are not suitable for operation or those cases which refuse operation, I refer to the radiologist. The results are not permanent but symptoms are relieved for about 12-18 months. If there is recrudescence, then a further course can be given. Sometimes after the 1st course, as a result of the shrinkage that occurs, the symptoms, the general condition and the blood picture improve so much that an operation can be undertaken. The operation however is always more troublesome because the prostate becomes fibrosed and adherent. The patient should be warned that he must not expect results till four to six weeks have elapsed after the X-Ray treatment.

Radium application has not been such a success. Both Radium itself and Radon have been tried.

Before I turn to the medical aspects of treatment I must mention the prostatic punch. This has no *locus standi* in the treatment of the prostatic, but for a fibrous prostate or for enlarging a narrowed int. meatus it has been used. Personally I have no experience with it and I should certainly prefer McCarthy's resectotome for these purposes.

Turning to medical treatment, Ergot and Strychnine, Hyocyanus and Belladonna have no value in the treatment of this condition.

Injections of Carbolio Acid have been tried and like those given elsewhere for other diseases, they induce reaction and fibrosis. They are too uncertain in their



effect and are not to be relied upon. Sometimes they cause severe reactions.

The only injections that have some effect on the prostate are those of the Testicular Hormone. By these injections the enlargement is slowed down, there is sometimes even a temporary regression of symptoms, this latter probably the result of diminished congestion. As an adjunct to X-Ray treatment it is of value in those cases where a radical operation cannot be considered. It should be given in 25 mgm. doses twice a week. As already mentioned vasectomy which had a temporary beneficial effect on enlarged prostate, owed it to extra production of this hormone.

I have records of 154 cases. Some of my records were lost and the earlier ones are meagre in detail.

Of the 154 cases, 5 were between 45-50, 63 were between 50-55, 54 were between 55-60, 29 between 60-70 and 3 above 70. It can be seen that this disease is most common between 50-60.

There were 71 Hindus, 37 Parsis, 17 Mahomedans, 13 Jews, 11 Christians, 1 Armenian and 4 Europeans.

In 26 the symptoms extended for less than 6 months, in 42 between 6 months to a year, in 61 between a year and two, in 13 between two and three years, in 9 between 3-4 years and in 3 for more than four years. Amongst the last was a patient with symptoms extending over 20 years.

Of the 154, 131 were operated on. Twenty-three were not interfered with. Of these, two had less than two ounces of residual urine and nothing was done for them. They were lost sight of.

Sixteen refused operation or were unsuitable for operation and were advised X-Ray. Of these 16, four are alive today, 1-3 years after starting treatment, 6 are dead 1-4 years after starting treatment and six have been lost sight of. Those observed showed improvement after the 1st sitting but the good effect diminished with each succeeding course of X-Rays and the symptoms recurred sooner and sooner.

The other five non-operative cases had repeated retention with septic pyelo-nephritis. They all had clinical symptoms of chronic uraemia and died from a week to four months after tying in the catheter.

Of the 131 operated cases: nine were permanent cystotomies because of very poor kidney function. Of these nine, one died suddenly of cardiac failure on the eve of his discharge from the nursing home. Three others died one to four years after operation. One improved so much that he had a successful prostatectomy done by another surgeon. I have no news of the remaining four.

Of the remaining 122, 96 were two-stage and 26 one-stage operations.

Of the 96 two-stage operations, the 2nd stage was carried out in 10 days after the first in seven cases, within fourteen days in 81 cases, within three weeks in 5 cases, in four weeks in two and after six weeks in one case. The usual time is two weeks. The delay was caused by marked sepsis in six cases, bronchitis in three cases and pneumonia in one case. One case died suddenly two months after discharge. The operative mortality (in the Hospital) was twelve deaths or 12.5 per cent. The causes of the death varied but the most common were uraemia and pneumonia. Since the introduction of the sulpha drugs we have more control over sepsis and pneumonia and I feel sure that Penicillin will help us save some more patients. Of these twelve deaths 9 were during the 1st stage and three during the 2nd. It must not be forgotten that many of these cases were on the border line of bad risk.

Of the 26 one stage operations; there was one death by sudden cardiac failure on the 7th day and one by pneumonia, a mortality of 7.7 per cent. The sudden cardiac failure has sent up the mortality rate in otherwise selected cases. The pneumonia death was before the sulpha drugs came in.

Of the 154 cases no less than 56 or 36.4 per cent were seen by me first during retention. 91 or 59.1 per cent came during the stage of difficulty. Only seven cases came

during the stage of burning or hesitation. Of these, five had  $5\frac{1}{2}$ ,  $6\frac{1}{2}$ , 7, 9, and 11 ozs. residual urine. The remaining two had less than two ounces, though the prostate felt definitely enlarged. No cystoscopy was done in these two cases.

Cystoscopy was done in 86 cases.

When first seen 79 cases had pus in the urine. In 17 cases the urine was faintly opalescent, in 46 opalescent and in 16 cases it was quite turbid.

Eleven cases gave a history of previous haematuria.

Five cases gave a history of gravel or a previous operation for stone. In twenty-nine cases stones were found at operations. In seven cases the stone was single, in four-

teen cases multiple and in eight cases there were seed calculi.

Vesical diverticula were found in three cases. In only one case was it removed.

Urea clearance test was done in 23 cases, urea concentration tests were made in 76 cases. Phenol-Sulphone-phthalein tests were made in 44 cases.

Packing the prostatic cavity was done six times on the table and eight times for recurrent bleeding.

The follow up records of living cases are very poor and are not worth recording. One of my patients is alive and healthy twelve years after operation. He came to me with difficulty in micturition having suffered from it for four months. His urine was clear and phenol phthalein index was 70 per cent for three hours.

## THE SURGERY OF ENLARGED PROSTATE

by S. S. ANAND, F.R.C.S. (Eng.), Surgical Department, King Edward  
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The attention of the medical profession has been focussed on the problem of obstruction caused by enlarged prostate for more than a hundred years and yet there is no unanimity of opinion regarding the treatment of this condition. At the present moment, however, there are two schools of surgeons: one who favour the open operation, perineal or supra-pubic; and the second who perform the endoscopic resection.

If we study the history of prostatic Surgery we notice that there have been periods of advance followed by periods of stagnation. McGill of Leeds and Belfield of Chicago published in 1887 technique of operations designed to relieve prostatic obstruction and both operators performed a partial supra-pubic prostatectomy. White of Philadelphia in 1893 advised that castration of the patient would lead to the shrinkage of

the enlarged prostate. This idea was taken up by some, to be followed by the operation of vaso-ligation. These procedures turned the attention of the Surgeons from the direct problem of urinary obstruction to the indirect method of dealing with the condition leading to delay in further advance.

In the beginning of the present century attempts were made to solve the problem by removing the prostate more or less completely—both by perineal and the supra-pubic routes. The perineal approach was perfected by Zuckerkandl, Alberian and Young. And to-day Young is the chief exponent of this method. We have had no experience of this method.

The supra-pubic route was first advocated by Fuller in 1895. To Freyer, however, must be given the credit of first describing

the method in detail in 1901 and it is mainly through his efforts that the operation came into universal usage. It became possible to remove the prostate more or less completely and with a good measure of safety.

During the following fifteen years intensive research was made into the problem of renal efficiency with the result that the pre-operative estimation of blood urea became a routine procedure. Some Surgeons prefer the urea-clearance test. We have, however, relied on the former because of its greater simplicity.

In 1920 Thomson Walker described the open operation with control of bleeding under vision. But the increased shock to the patient and the rise of the mortality rate have prevented this procedure from being generally adopted.

In 1929 Harris described his operation of the obliteration of the prostatic cavity with the main idea of arresting haemorrhage and re-trigonisation of the prostatic cavity. This operation can hardly be attempted in the presence of sepsis which is no frequent in the type of cases met with in our part of the country.

The next advance in the technique of the operation was the per-urethral resection of the prostate. In 1935 Gershan Thomson and his colleagues at the Mayo Clinic reported a series of 451 cases without a single mortality in which prostatic obstruction had been treated by the cold punch. According to the opinion of these workers the safety of the operation excels that of any other method of surgical operation available. To Americans must be given the credit of popularising the operation. The average stay in the hospital is said to be from 3-7 days as contrasted with the period of three to four weeks taken by the healing process in the other method. This short stay, however, doesn't include in the statistical records the subsequent deaths due to cardiac failure, sepsis, pneumonia, embolism, etc., which are included in the statistical record of the supra-pubic operations. A further criticism is that the per-urethral re-

section has not eliminated the two complications of which we are all afraid viz., sepsis and haemorrhage. It has in fact introduced a third: extravasation. Young has recently analysed histories of 200 cases of per-urethral resection with imperfect results and has come to the conclusion that the complete enucleation of the prostate is the operation of choice—especially in cases of larger hypertrophy. In view of the diverse opinions and in the absence of any special training in Endoscopic resections, we have never hazarded to undertake per-urethral resection of the prostate in our cases.

We have treated 42 cases of enlarged prostate in our surgical unit at the Mayo Hospital, Lahore, during the last two years. We have come to the conclusion that the Freyer's method of blind enucleation, either in one stage or two stages is the simplest and is the one which can be used by the majority of general Surgeons. In fact it is still by far the commonest operation performed by the Surgeons the world over for this disease. The two-stage prostatectomy is always attended with less risk to the patient.

The criteria which helps us to decide in favour of a two-stage prostatectomy are Severe haematuria, repeated attacks of retention; evidence of poor renal function, evidence of infection of the urinary tract and signs of incipient uraemia, viz., drowsiness, dry tongue, slow pulse accompanied by subnormal temperature, and any chronic respiratory disease. Experience has shown that any of the foregoing conditions demand a "two-stage" rather than a one-stage operation.

In the one-stage cases we depend upon the in-dwelling catheter for preliminary drainage. This is carried on for a period of about ten days. The catheter should not be allowed to hang otherwise sometimes a meatal ulcer is likely to develop and the prepuce should not be allowed to be retracted as this may produce para-phimosis. In those cases where we use an in-dwelling catheter the bladder is irrigated once in 24 hours the fluid used being ordinary saline lotion, this being changed to 1 in 1000 silver

nitrate lotion in infected cases, besides injecting 2 drachms of 2% mercurochrome solution in the bladder at the end of irrigation. In many cases this procedure helps in markedly improving the general condition of the patient and the renal function as shown by the lowering of the blood-urea.

Here it may not be out of place to point out the difference between acute and chronic retention.

*Acute retention* comes on suddenly. The patient looks ill, complains of pain and thirst, and the tongue may be dry. He can be catheterised without any danger of a sudden onset of uraemia due to back pressure on the kidneys.

*Chronic retention* on the other hand is a serious condition: the patient may be a picture of health, may complain of no pain or discomfort with a bladder distended up to the umbilicus and may even have a moist tongue. Such a case, however, shows high blood urea, and may suddenly go into a grave condition of Coma by the sudden emptying of his bladder. These cases, besides, have a great tendency to develop paralytic ileus. The condition can be dealt with by an in-dwelling catheter with an arrangement for slow decompression: a spigot being applied to the end of the catheter and 2-3 ounces of urine being allowed to drain 2 hourly till the bladder is completely empty. Then the catheter is connected by a glass connection and a rubber tubing to a urine bottle hung to the bed frame. It is essential to give plenty of fluids to these patients.

If a catheter cannot be passed, supra-pubic drainage can be instituted by a self-retaining catheter passed through Kidd's Trocar and Canula. This procedure is undertaken under local anaesthesia.

We may now summarise the contra-indications to a one-stage prostatectomy:

1. A large prostate or a prostate which is very congested is likely to cause alarming primary haemorrhage if removed at the first operation. After supra-pubic drainage the congestion is markedly reduced and even

the size of the prostate may become less. Experience has shown that bleeding is much less after a second stage prostatectomy than after a one-stage operation.

2. Acute or chronic retention contra-indicates a single stage operation.

3. Patients with arterio-sclerosis and hypertension do well under a two-stage operation. In several cases hypertension is reduced after the first stage.

4. Large amounts of residual urine.

5. Blood urea above 60 mgms. per 100 c.c. of blood.

6. A pulse rate of 100 per minute or more is a sign of toxæmia and is regarded a contra-indication.

7. Infection of the urinary tract needs a period of supra-pubic drainage.

*When to proceed with the second stage.*—The second stage is only undertaken when the patient has safely been able to combat the ill-effects of back pressure on the kidneys as shown by the lowering of blood urea; and also when the general condition of the patient has improved. The patient is encouraged to walk about. The moral effect of being allowed up is tremendous on these patients and soon they are ready to face the ordeal of the second operation with confidence. It must be mentioned that in several cases the general condition of the patient does not allow the second operation for months and some of them eventually have to pass their days with a permanent supra-pubic fistula.

*Anaesthesia.*—Most of our first-stage operations are performed under local anaesthesia. For the second stage we have invariably used the spinal anaesthesia unless there is some definite contra-indication to its use. The usual premedication in the form of morphia gr. 1/6 with atropine gr. 1/100 is used in these cases.

*Technique.*—Mid-line supra-pubic incision is used to reach the bladder.

Freyer's technique of blind enucleation has been used in all our cases. No attempt is made to remove tags or secure bleeding

points in the prostatic cavity. Primary haemorrhage is controlled by irrigation with hot saline. In some cases packing with gauze had to be undertaken—this certainly adds to the risk of infection and prolongs the convalescent period. The gauze pack is removed after 48 hours. We have no experience of the haemostatic bag. In cases who have had considerable bleeding blood-transfusion is used as a routine.

The bladder is closed round a large supra-pubic drain, with a rubber dam drain in the retro-pubic space. The rubber drainage tube is connected by a glass connection to a tube leading to a bottle hanging on the bed frame.

We have not used ligature of the Vas in any of our cases before the operation.

*Post-operative Measures.*—The siphon drainage is generally sufficient to keep the patient dry.

Daily bladder irrigation is done per urethra. The solution used is warm saline, and in septic cases 1 in 1000 silver nitrate lotion. The patient is encouraged to get up as soon as possible. As a rule the majority of our cases start moving about by the tenth day.

The supra-pubic tube is removed on the 9th or 10th day and a urethral catheter is tied in. The abdominal wound closes in three to four days, when the in-dwelling catheter is removed, and the patient passes his urine with ease and comfort.

*Analysis of Cases.*—In our series 42 cases of prostatic enlargement were admitted in our surgical unit. The youngest patient of this series was 46 years old, and the oldest was 100 years. The average age being 65.2 years.

Of these 42 cases :

- 8 patients had their prostatectomy in one stage.
- 13 patients had their prostatectomy in two stages.
- 11 patients had only suprapubic drainage.

10 patients refused operation.

Of the 21 cases who had their prostatectomy completed 3 died, giving a mortality rate of 14.3%. Of the 11 cases who had only supra-pubic drainage 4 cases died giving a mortality rate of 36.6%.

It will be apparent therefore that most of the deaths occur during the first stage of the operation. Those who have been able to survive the first operation can face the second operation with a much lesser risk.

The high mortality figures are due to the fact that most of our cases arrive in the hospital in the late stage of the disease, many of them are the subjects of chronic retention with uraemia, most of them arrive in a devitalised condition, and a considerable number with infected urinary tracts. It is not easy therefore to reach the standard set by many master surgeons. The only hope lies in the education of public opinion so that the cases come to us in an early stage of the disease.

## CONCLUSION

1. Emphasis has been laid on the indications for two-stage prostatectomy.
2. Mention has been made regarding the difference between acute and chronic retention. The treatment of the latter condition has been stressed.
3. It has been emphasised not to proceed with the second stage of the operation till the drainage of the bladder has produced the maximum benefit.
4. Mention has been made that the greatest risk to the patient is after the first stage of the operation.
5. The Comparatively high mortality in our series is due to the late stage of the disease at which most of our patients present themselves for treatment.

I am deeply indebted to my chief—Lt.-Col. A. Sargood Fry, C.I.E., I.M.S., for placing the records of cases which were under his care, at my disposal, and for permission to operate on some of them.

## DISCUSSION

*Perineal Prostatectomy*—Dr. V. M. Kaikini: Altogether about forty prostatectomies were performed by me. Out of these about twenty (20) were performed by the perineal route and the rest by the supra pubic. In the operation by the supra pubic route I had four deaths. One death was due to haemorrhage and the other due to uraemia. Lately I did more of the operations by the perineal route. Out of the 20 cases I did by the perineal method I had four deaths. One death was due to haemorrhage, one to acute epididymo-orchitis, and two to uraemia. All these deaths occurred in the first half of the series of the cases. In the beginning my technique was a bit faulty. Instead of reflecting backward the capsule of the prostate along with the posterior wall of the urethra which is to be sutured back in place after the prostate is removed I used to reflect back the Denonvillier's fascia only and remove the prostate along with the capsule and the urethra. This manoeuvre in which the urethra was not stitched to the opening in the bladder usually left a urethral fistula for some days and prolonged the convalescence. Moreover in the case that died of epididymo orchitis I had not done vasectomy which is essential in this method of operation. In none of the early cases was preliminary supra-pubic drainage done but the bladder was drained by a catheter in the urethra. I think all these factors increased the mortality of the operation. In the later operations supra-pubic drainage and vasectomy were done as the first stage operation and then the prostate was removed by the perineal method; and the mortality was nil.

No doubt the operation by the perineal route is definitely more difficult than by the supra-pubic route; but there are so many advantages. In the first place one does the operation under direct vision. Every bleeding point in the urethra and the neck of the bladder is seen and can be tied. The urethra is reconstructed and every raw surface is epithelialised. When properly done the post-operative shock is definitely less than in the supra-pubic method, and the convalescence is more comfortable and much shortened. Taking all these things into consideration the mortality rate is bound to be much lower in the properly done perineal operation than in the supra-pubic type, as is claimed by Young. All the above operations were done according to the same method.

But the chief advantage of perineal method lies in the fact that it is the only method by which a radical operation could be done for a malignant prostate. The method described by Pauchet does not seem to be so radical.

In my experience the atrophied fibrous type and the hypertrophied middle lobe type with the tumour projecting in the trigone of the bladder are not suitable for the perineal type of operation.

although an experienced operator would remove any type of prostate by this method.

The three risks in this method of operation are (1) Incontinence of urine. This can be prevented by being careful in not injuring the external urethral sphincter by opening the urethra as far back as possible. (2) Leaving behind an urethral or faecal fistula. In the majority of cases these fistulae heal up spontaneously. In my two cases of carcinoma prostate these fistulae did not heal up and the patients died eight months and twelve months after the operation respectively. The first patient had been treated in another hospital for malignancy with radium and adhesions had formed between the prostatic capsule and rectum and in trying to separate the rectum the rectal coat got torn and fistulae formed which did not heal up. In the second case faecal fistulae formed during the convalescent period and could not be closed. The patient died of secondaries in the lung.

*H. L. Vaidya*: Out of 120 cases of Senile Enlargement of Prostate admitted under his care in the Sir Takhtsingji Hospital, Bhavanagar, during last five years 1940 to 1945, only 45 submitted to operative treatment; suprapubic operation was done in 43 cases; Transurethral Endoscopic diathermy resection in the other two. 3 out of the 43 suprapubic cases were discharged after simple suprapubic drainage as they were found to be bad risks for prostatectomy; the remaining 40 cases underwent complete Prostatectomy in one stage, and 34 in two stages.

The youngest patient was 45 years and oldest, 75 years. Duration of the complaint—varied from a maximum of 7 years to a minimum of 2 weeks. Residual urine—maximum 20 oz.; Blood urea—maximum 90 m. grms. per 100 c.c. reduced to 35 m. grms. 3 weeks after the first stage operation.

Vesical calculus complicated enlarged prostate in 9 cases. History of Gonorrhoea in 8 cases. Size of Prostate removed—maximum 3½ oz., minimum ¼ oz., average 1½ oz.

*Post-operative mortality*—Out of 45 cases, 8 died = 18%; Out of 8 deaths, 5 were due to Uraemia; 3 were due to Pneumonia; none died of haemorrhage; 3 died after first stage; 5 died after the second stage.

*Other complications: Epididymo-orchitis*—16 out of 45. The majority of cases of enlarged prostate sought hospital admission for exacerbations of symptoms during rainy season. He wished to know from the speaker whether he had also observed this and how he would explain it. He also wished to know about the incidence of Epididymo-orchitis as a complication and how to prevent it. Would he advise preliminary vasectomy as a routine procedure? What was the cause of Uraemia developing after the first stage and what treatment he would advise for counteracting threatening uraemia after prostate operations.

**R. N. Cooper:** The beneficial effects of vasectomy on the size of the prostate were doubtful. In one particular case the operation did not in any way influence the size of the prostate. Contrary to the expectations raised by Steinach, the patient actually stated that he had lost what little virility he possessed. He also did not believe that X-Ray irradiation of the prostate did any good to the patient. At the most it controlled haemorrhage in the congestive phase. Epidural anaesthesia with 25 c.c. of a 3% solution of Novocaine supplemented with local infiltration of the abdominal wall with 1% Novocaine gave very satisfactory results. The incision into the bladder should not be carried too low down. Haemorrhage from the bladder wall in this region was particularly troublesome. He did not employ the "finger in the rectum" technique to steady the prostate. He preferred to maintain a hold on the prostate by passing an ordinary rubber catheter per urethra into the bladder and bringing the eye-bearing end right out of the abdominal incision and holding the two ends of the catheter together in the left hand while using the right hand for enucleation.

He referred to persistent pain in the region of the symphysis pubic after an operation for supra-pubic prostatectomy. It was due to an aseptic Osteo-myelitis in the region. It took sometime to clear up.

He pointed out the necessity for repeated passage of dilators into the urethra to prevent stricture formation. He also stressed the importance of forced water intake during the post-operative period.

Administration of about 300 c.c. of matched blood was now a routine procedure with him during the operation.

**Dr. C. S. Worah:** Referred to a series of 50 consecutive cases of Enlarged Prostate at the K. E. M. Hospital, Bombay, in the last 3 years.

The commonest symptom for which treatment was sought was retention of urine (76% of the cases). Frequency, though present in 88% of the cases, rarely made the patient seek treatment (6%). Haematuria was quite rare compared to the figures of other workers. 6% of cases while Young reports 24%. More cases of enlarged prostate were admitted in the rainy season than in any other season.

**M. V. Bhajekar:** Referred to a case under his care who developed symptoms of enlarged prostate in 1941. He was given hormone treatment and was quite well up-to-date.

He used a syphon action apparatus for drainage of the bladder which is much simpler than the one shown by the speaker. It keeps the patient quite dry, without wetting his bandages.

He had observed that some of the prostate cases developed a peculiar mental apathy after their

first operation. It is a common experience that patients operated on for other conditions like—appendicitis or hernia—are always eager to get out of bed and resume normal life. Prostate patients, on the other hand, feel more inclined to stay in bed and are not inclined to make efforts to regain their normal health. In fact they have to be coaxed and sometimes forced to sit up and take to more normal habits; and until they start doing this they do not improve in their general condition and very often their 2nd operation is delayed.

**Dr. V. P. Mehta** gave, further details regarding the 50 cases from the K. E. M. Hospital referred to by Dr. Worah.

1. Weight of the gland varied from 17 gms. to 85 gms.

2. About 17 to 18% of the prostates removed as benign enlargement turned out to be carcinomas on histological examination.

3. Patients started passing urine per urethram after the prostatectomy as early as the sixth day.

4. Post-operative haemorrhage occurred in 11 cases out of 38 and in two cases was fatal.

5. In those cases where packing, suturing or pilchers bag were employed, haemorrhage occurred less frequently and when it did occur it could be controlled easily and was never fatal.

6. Mortality after operation was 13%.

**S. B. Gadgil:** 1. The Vasectomy performed previous to the removal of the prostate, in his opinion, was mainly to prevent Epididymo-orchitis resulting from the spread of infection caused by the operation and not with a view to increase the resisting power of the patient.

(2) When facilities for clinical investigations such as urea-concentration test and any other tests were not available, he had depended on the Sp. Gr. of the urine. When the last two digits of the figure were above 10, he took it that the patient was fit for operation.

3. He had also noticed that a marked enlargement with even retention of urine has often subsided altogether after supra-pubic drainage, and did not know why it was so.

**Dr. M. Authikesavalu:** Transurethral prostatic resection cannot be condemned as an unsatisfactory operative procedure for Enlarged Prostate. I had the opportunity of observing the prostatic bed after transurethral prostatic resection through the cystoscope, while I was working at the Mayo Clinic, U.S.A., where the Urological Surgeons, Doctors Thompson, Emmett and Cook do transurethral prostatic resection for almost all their cases of Enlarged Prostate. Such a prostatic bed does not show any segment of Enlarged Prostate left over. They do the "Hot Punch" where the coagulation of the bleeding point is done simultaneously with the resection. Dr. Crevy at

Minneapolis, U.S.A. does a "Cold Punch", where the prostate is resected transurethraly, and the bleeding points coagulated later.

I have seen these prostatic beds post mortem, years after their transurethral prostatic resection in cases who died of some other ailment and I can assure you that prostatic beds were absolutely clean and devoid of any recurrence.

With proper choice of cases and with proper technique it is certainly possible to remove the Enlarged Prostate by the transurethral method just as in any other operative procedure. The failure of the operation is often attributed to the faulty technique and skill of the operator. Now that the war is over, many of us will be able to get these operating cystoscopes and do more transurethral prostatic resections. As we gain in experience and skill, I am sure we will find it as excellent an operative procedure as any.

The great advantages of transurethral prostatic resection are that post-operative confinement to bed is minimal and the patient is ambulatory in 3 to 4 days; there is no troublesome suprapubic urinary soiling of dressings; age is no bar to this type of operation; properly done, there is minimal loss of blood and the experienced operator does the entire resection in one stage, avoiding a second anaesthesia and surgery.

I have seen Dr. Young's colleagues at Boston, U.S.A., do Perineal Prostatectomy in almost all their cases with excellent results and it is a very popular method in the Eastern part of the United States.

I believe that in skilled hands, one type of operative procedure is just as good as the other, and none of these could be condemned as inadequate or unsuccessful, unless the surgeon gives a fair trial to such operative procedure employing the perfect technique and skill.

*R. Mahadevan:* I. First of all I want to stress a few points regarding diagnosis.

(a) *Chronic prostatitis mimicking senile enlargement.*—The importance of this lies in the fact that when the enlargement is due to chronic inflammation, the condition may respond to simple measures like periodical prostatic massage and iodine in some form by mouth. Sometimes, cases come with retention of urine and examination shows enlargement of the lateral as well as middle lobes, the latter becoming evident at the suprapubic drainage. A few days or possibly few weeks after drainage, it is found that the patient is able to pass urine per vias naturales and the prostatic enlargement has subsided almost completely. I think such cases are those, where the enlargement has been due to chronic inflammation subsiding with drainage. A true senile enlargement, result of an adenomyoma, is probably unlikely to respond to this treatment. However, the

practical point is this. If in such cases the suprapubic tube is clipped and the patient is then able to pass urine freely per vias naturales, the catheter may be removed, after retaining it clipped for a further two or three days to make sure that the troubles do not restart. The patient need not undergo the operation of resection of the prostate. The case below is a typical one in point:—

A man of 50 came to hospital on 28-8-42 with a history of frequency of micturition, increasing difficulty in passing urine and burning, of 6 months duration but particularly severe for 3 months. There was mild cystitis. Rectal examination showed marked uniform enlargement of both lateral lobes of the prostate. Bladder was found distended two fingers above the level of the symphysis pubis. Soft catheter passed in easily and the bladder was decompressed gradually. On 1-9-42 suprapubic drainage of the bladder was performed when a definite middle lobe enlargement also was evident. The bladder was drained by a big sized Winsbury-White self retaining catheter. On 15-10-42 rectal examination showed that the lateral lobes of the prostate had come down to normal size. Cystoscopic examination showed that there was no median lobe arrangement either. The supra-pubic catheter was therefore removed on 27-10-42. The patient was able to pass urine freely per vias naturales. He was kept under observation for a few more days and discharged cured on 6-11-42.

Some of my colleagues also have had experience of similar cases. The case cited above came with chronic retention. Sometimes, the symptoms are milder. There is no retention of urine and the enlarged lateral lobes become smaller and smaller after periodical prostatic massage and symptoms clear up. Tr. Iodine 5 m. in milk by mouth, thrice daily for a few days helps in the resolution. If there is any associated cystitis it requires treatment by the usual measures.

Sometimes patients come with complaints of sciatica, or symptoms suggestive of seminal vesicular colic. In some of these cases the underlying cause is chronic prostatitis and vesiculitis. Periodical massage of the prostate and the vesicles completely relieve them of their troubles.

(b) *Enlarged subcervical and subtrigonal glands of Albarran.*—Retention cysts, result of blocking of the ducts in the prostatic or urethral glands or in the trigonal area may give rise to symptoms resembling enlarged prostate. The condition may be evident on cystoscopic or urethroscopic examination or may become evident at the time of suprapubic drainage. If associated with chronic prostatitis, treatment as above may succeed. If the prostate also is enlarged, excision of the cyst or cysts and the enlarged prostate may be required.

(c) *Chronic interstitial nephritis may sometimes be mistaken for prostatic enlargement.*—A patient



may come with frequency of micturition and rectal examination may show a slight enlargement of the prostate to which all the troubles may be erroneously attributed. If, in such a case the specific gravity of the urine is very low and there is a trace of albumin in the urine, the possibility of chronic interstitial nephritis being the underlying cause must be excluded before any operative procedure is thought of. This is very important, for, if the prostate is removed in a patient where the troubles are due to chronic interstitial nephritis, he will almost surely die.

(d) Sometimes a hypertrophied inter-ureteric bar may cause retention of urine and in many ways resemble disturbance due to enlarged prostate.—The importance here lies in the fact that the treatment required is resection of the hypertrophied interureteric bar (or an enlarged flapping trigonal mucous membrane) and not removal of the prostate. True, the condition is often associated with enlargement of the prostate but may also occur independent of any enlargement of the prostate. The following case report is interesting from the fact that it occurred in a young girl of 14, where the question of prostatic trouble therefore did not arise. The patient had chronic retention of urine with overflow for 6 months and could never thereafter voluntarily void urine. She had been catheterized outside several times and there was severe cystitis. At the time of admission she was in extreme misery with wetting of clothes and ammoniacal smell, and had high fever. The bladder was found distended well up to the umbilicus. Very careful investigations, including lumbar puncture, neurological examination, etc. etc. could not reveal any cause. Opinion of the physicians also was taken and no obvious cause was detected. Skiagrams revealed nothing abnormal except for a suggestion of hydro-ureters in the intravenous pyelograms. At an exploratory supra-pubic cyst-

tostomy, a hypertrophied inter-ureteric bar was detected and this was resected (Figs. 1 and 2). The patient thereafter recovered her control and was able to pass urine freely. It is now just

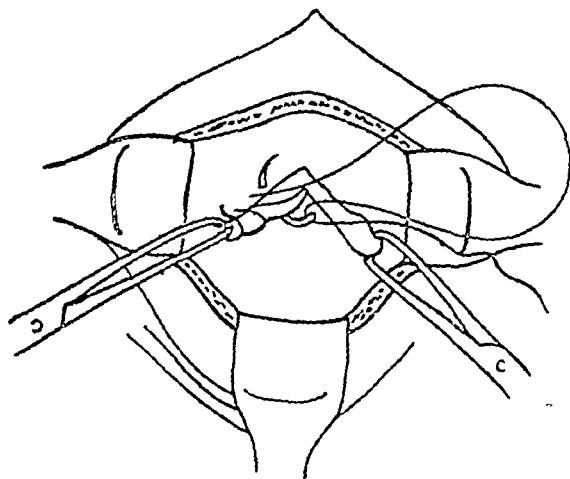


Fig. 2. Removal of trigonal bar or flap which had caused retention of urine. Suture of edges of resulting wound. (After H. H. Young.)

(Both the above figures are from R. P. Rowlands' & P. Turners' Operations of Surgery.)

under four years and she is passing urine freely but her present troubles are due to a persistent mild chronic cystitis with a small amount of residual urine. However, this case typically shows the effect of a hypertrophied interureteric bar.

(e) The importance of noting findings on rectal examination both before and after emptying a distended bladder.—Sometimes patients come in with a markedly distended bladder and rectal examination shows what appears to be an enlargement of the prostate. This however is not there, when re-examination is done after the bladder is emptied. Probably the stretched distended bladder wall gives rise to a feeling suggestive of an enlarged prostate. Sometimes the reverse occurs. There appears to be no enlargement of the prostate but an obviously enlarged prostate is evident when re-examination is done after decompression of the bladder. Such changed findings are by no means common, but they do occur now and again. These facts must be remembered and the findings of rectal examination must be recorded in the case sheet both before and after the bladder has been emptied, for a correct assessment of the state of affairs.

II. The second point I would like to state is that a very great majority of our cases come often with acute retention or chronic retention with overflow and with or without cystitis. I have had no single case where the patient could reasonably have been considered to be fit for a one stage operation.

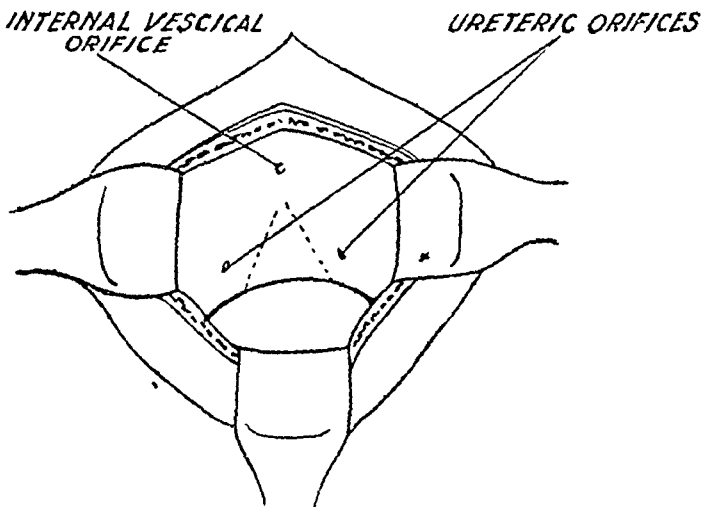


Fig. 1. Removal of trigonal bar obstructing the exit from the bladder. The wedge indicated is excised from the bar or flap. (After H. H. Young.)

Indeed some are so chronically ill that even after months of suprapubic drainage they never seem to reach a stage fit for prostatectomy. I have now on hand two such patients, but I must state both are very elderly patients, one 71 years and one 80 years old.

III. Sometimes the first evidence of prostatic trouble is as an unexpected post-operative complication, where, because of the operation the patient has perforce to be bedridden. Thus, in an elderly patient operated on for a straight forward inguinal hernia, troubles due to retention of urine the result of an enlarged prostate evidenced itself only after the operation. Previous history did not suggest any prostatic trouble. He developed high blood urea and became moderately uraemic. Intravenous drip 4.28% solution of sodium sulphate in 5% glucose and other measures of treatment luckily brought the patient round. After the patient was discharged he was ambulant and was found a year later to be quite comfortable and without any obvious prostatic trouble. In another case admitted for Colles' fracture, the patient, an old man of eighty, became uraemic and actually comatose; with intravenous drip sodium sulphate in glucose he revived in a miraculous fashion. He was known to be alive and comfortable months afterwards. Indeed, in this patient I had earlier refused to operate for hernia because I knew he had an enlarged prostate and anticipated trouble.

IV. *Some details about operative technique.*—Spinal anaesthesia is always of great help, but the anaesthetic effect should be confined to the level of the umbilicus or even lower. If haemorrhage is arrested under vision, post-operative troubles are minimal. Packing and other similar methods of arresting haemorrhage are very poor second bests. Once the haemorrhage is carefully arrested it is enough if the bladder is drained by a big sized Winsbury-White's catheter. Marion's tube is very uncomfortable to the patient because of its large size and extreme rigidity.

V. *Malignant Prostate responding to Stillboesterol treatment.*—A man of 45 is now under my care with a clinically obvious malignant prostate, who has responded well to the administration of "Stillboesterol." He came on 12-7-45 with a history of difficulty in passing urine, starting 5 days earlier and later resulting in complete obstruction. Rectal examination showed markedly enlarged hard nodular lateral lobes with infiltration into the right lateral rectal wall. Bladder was markedly distended. Suprapubic cystostomy revealed markedly enlarged intravesical projection of a hard nodular prostate fixed to surrounding structures. He was put on stillboesterol by mouth and had 281 mgms. in about 3 months. The mass has decreased definitely in size, the nodularity is much less and the patient is able to pass urine through the urethra easily, if the suprapubic tube is clipped. The infiltration in the rectal wall is

however, still quite obvious and if anything is on the increase. Attempt at aspiration biopsy failed to give any material sufficient for examination. Unfortunately a piece was not taken for biopsy at the time of the suprapubic cystostomy, but the patient is still under my care and I hope to verify the clinically malignant condition by a biopsy.

VI. *Prostatic abscess as a source for pyaemia.*—Recently I had a case of prostatic abscess where the patient developed pyaemia. The abscesses were freely drained, and penicillin therapy instituted, but even with all this the patient went downhill and was taken home very ill. He was a diabetic and this possibly had an important bearing on the unfavourable course. The point is, in cases of pyaemia of obscure origin, one must remember the possibility of the prostate being the underlying focus of infection.

VII. Dr. Moolgavkar was careful to stress on the fact that everybody has his own pet details as to technique and is likely to pronounce his method as the method of choice. In spite of this, I may be permitted to say the following. All the dangers of the operation inclusive of infections and uraemia are directly or indirectly mainly connected with improper haemostasis. Blood clots, and packs in any form to arrest haemorrhage are all fertile sources of infection. Passage of catheters up the urethra is another equally potential source. If haemorrhage is arrested properly, almost all complications can be avoided. It is seriously suggested that the best way of arresting haemorrhage is by the skillful use of diathermy coagulation and avoidance of any ligature material for the purpose. (W. H. Hey, 1945).

In conclusion, may I suggest that the few sudden deaths that occurred a few days after operation in Dr. Moolgavkar's series were very possibly due to "Embolism."

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P. Chatterjee: Retention of urine in patients suffering from an enlarged prostate may be either acute or chronic. Many of these patients come to treatment for the first time during an attack of acute retention. It is difficult often to make out the exact aetiology of the onset of acute retention. Cold and alcoholic excesses that are supposed to play such an important part in some places do not always operate in Bengal. Whatever

they might be, sudden acute congestion of the prostate undoubtedly plays the master role in the pathology. I have found two factors out of others inducing this congestion and initiating an acute retention. They are:—

- (i) Having had to hold urine for a long time either due to want of facility to urinate or out of shyness.
- (ii) Taking of Quinine—to ward off an attack of fever or to cure it, malarial or otherwise. The incidence of acute retention after the ingestion of Quinine has been so frequent that I would not consider it a mere coincidence.

Dr. Moolgavkar is inclined to think that prostatic patients with acute retention do not suffer as miserably as patients with stricture and that spasms do not play an important part in the symptomatology. I do not agree with this idea. These patients do usually suffer from great discomfort and violent spasms—so much so that there is great tenesmus spasm, mucus discharge per rectum and even prolapse.

Talking of residual urine—I have found that confirmed prostate cases may carry on without any residual urine. In others residual urine is fairly large in quantity.

*Cystitis and enlarged prostate.*—Dr. Moolgavkar states that he treats them with Hexamine. If the bacteriological flora is B-coli, hexamine may be considered the best drug, but my experience of the bacteriological flora of cystitis in these cases is that B-Coli is not obtained on culture. Other pyogenic cocci, e.g., Streptococcus and staphylococcus and B-pyocyanus are fairly commonly met with independently or in association with B-coli. There is therefore place and necessity for the administration of other effective anti-infective

drugs or chemotherapeutic drugs in the treatment of this cystitis. Cystitis is a difficult condition to be completely eradicated. This often stands in the way of successful and peaceful operative treatment in many cases. It is difficult to get a patient for operation who is not already infected. Most cases that are received for treatment have already indiscriminate catheterisation and come with Cystitis. It is safer to establish direct drainage in them.

There are cases where after an acute retention and drainage it takes a long time, say three weeks, at times four weeks and even more before natural urination is established. After this is over, however, some of them carry on a fairly comfortable life so long as a second attack of retention does not occur. I would like to ask the Speaker as to how long he considers it safe to persist with catheter drainage after an attack of acute retention and what circumstances would lead him to interfere.

While doing a prostatectomy by the Suprapubic route, I have found it necessary to pack the prostatic bed very frequently. Suturing the prostatic bed to stop haemorrhage and to reduce the raw surface which ought to be the ideal has not been mentioned by the speaker. I would like to know when he removes the pack? I know of people who would not remove them for 6 days.

The speaker is of opinion that when prostatectomy is not desirable and when the patient refuses the operation, deep X-Ray therapy gives relief for 12 to 18 months. This has not been my experience. Judging from the results of deep therapy in a fairly large number of cases, I am of opinion that the relief of symptoms is very transitory. I would like to know from the lecturer if he has any experience about the role of Diathermy in the treatment of these cases.

## VOLVULUS OF THE STOMACH

*A Case Report by K. KRISHNAMURTHY, M.B.B.S., L. F. Hospital,  
Davangere, Mysore State.*

Unlike Volvulus of the sigmoid, volvulus of the stomach is a rare condition. Berti in 1866 was the first to report the condition of complete volvulus in a patient at autopsy. Laewen in 1927 reviewed about 40 known cases. Weeder reports that till 1939 there

have been only 70 published cases of complete volvulus.

A consideration of the mechanism of and the etiological factors producing volvulus of the stomach will not be out of place. Buchanan in 1930 and Osman Hill and Mil-

roy Paul in 1939 in two very interesting articles have reviewed the morbid anatomy and etiology of this condition.

The stomach is normally fixed by the Oesophagus to the hiatus in the Diaphragm and is reinforced by the gastro-phrenic ligament. The rest of the stomach lies comparatively free, suspended by folds of peritoneum. The pylorus is however a relatively fixed point on account of the retro-peritoneal position of the Duodenum. Hence a volvulus of the stomach can occur in relation to a line joining the fixed points, viz. cardia and pylorus.

Volvulus of the stomach may be complete or partial. The total form is not strictly a complete volvulus from the anatomical point of view, the gastrophrenic ligament being sufficiently strong to hold the left side of the fundus steady even in extreme torsion. Von Haberer described two varieties of complete Volvulus.

- (1) As in volvulus of the sigmoid, the viscus pivots round a taut mesentery.—Volvulus Mesenterio-axialis.
- (2) The stomach rolling on its own long axis which is a line passing from pyloric to cardiac end.—Volvulus Organo-axialis.

### VOLVULUS MASENTERIO-AXIALIS

In this the rotation is from right to left around a vertical axis at right angles to the Cardio Pyloric line. The pylorus, which is

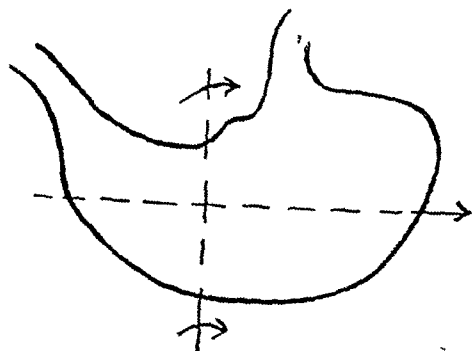


Fig. 1. Volvulus Mesenterio-axialis.  
(Showing the axis of rotation)

more mobile in these cases, passes in front of the fundal end from the right upwards and to the left; a small reciprocal movement being seen at the fundus. The anterior wall, sharply kinked looks backwards while the posterior wall presents under the abdominal wall veiled by the greater omentum. The right half of the colon is carried with the pylorus, upwards and to the left and becomes greatly distended.

### VOLVULUS ORGANO-AXIALIS

In this the stomach rolls on its own long axis, the relatively mobile pylorus is drawn towards the fixed Cardia and a deep sulcus appears on the lesser curve. As the stomach rotates upwards from below, the greater curvature comes to lie below the liver while the lesser curvature rotates to the position of the greater curvature. The anterior sur-

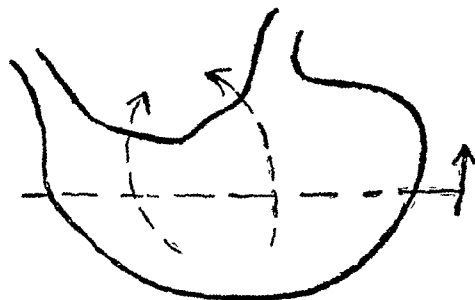


Fig. 2. Volvulus Organo-axialis.

face looks backwards and the posterior surface now presents behind the abdominal wall, veiled by the mesocolon, if the transverse colon is also carried in the upward twist. In some cases the colon remains below, when the stomach is covered by the expanded thin layer of greater omentum as in the present case. There may be displacement of organs like spleen, pancreas, colon, etc.

Considering the extent of twist, there is remarkably little interference with the circulation. While congestion is the rule, gangrene is never observed.

### PARTIAL VOLVULUS

This is of the organo-axialis type (Buchanan). Partial volvulus is always associated

with Diaphragmatic-Hernia, congenital openings in the mesenteries, and with intrinsic gastric lesions like hour-glass stomach, perigastritis, gastric ulcer, etc. It is usually subacute in nature and has little interference with the circulation.

Total volvulus is most often "Idiopathic" coming on suddenly in an apparently healthy individual. In some cases slight elongation of the gastro hepatic omentum and ptosis of the stomach is noticed. Sex incidence is equal, and it occurs in young individuals. Cases have been described in children and is supposed to be due to the horse-shoe shape of the stomach and the pylorus being high—a condition of relative gastropnoxis.

Whatever may be the predisposing cause, the immediate exciting cause is invariably overfilling of the stomach, followed by vigorous peristaltic and antiperistaltic waves. In the organo-axialis type it would appear that the actual volvulus is produced by an exaggeration of the normal forward movement of the left border of the stomach in peristalsis, the result of extremely vigorous peristaltic waves. In the mesentrio-axialis type excessive peristaltic waves in a long overloaded loop with a narrow basis of attachment is the mechanism, similar to that of volvulus of the sigmoid. Once volvulus has occurred reduction is prevented by the pressure of the anterior abdominal wall, which holds the distended stomach between the abdominal wall and the diaphragm (Thorek).

### SYMPTOMATOLOGY

In the total variety the onset is acute; severe epigastric pain and vomiting are the earliest symptoms. The vomit consists of stomach contents only. This soon ceases, to be replaced by uncontrollable retching, which is very characteristic. There is great distension of the upper abdomen in the epigastric and umbilical areas. Stomach tube cannot be passed. If operation or death does not cut the process short, it usually ends in perforation of the stomach. This may account for some cases of so called

"Idiopathic" rupture of the stomach found at autopsy.

In the partial variety there is usually an old-standing history of gastric disturbance. Onset is also fairly sudden, with acute pain, repeated vomiting of watery fluid not tinged with bile. The stomach tube can be passed in many cases. In these cases rupture of the stomach does not occur.

### CASE REPORT

*History.*—Patient, Mohammedan male, 26 years, was brought to the hospital on 18-2-1945 at 3 A.M. with the following history. He was in perfect health the previous day. He had been to the pictures and returned home at 11-30 P.M. and had a good meal of rice, curry and eggs. A short time after, he felt his abdomen getting distended and had acute colicky pains in the abdomen. Immediately after the onset of pain, he vomited twice when he brought out part of what he had taken, but subsequently, had only severe retching. Since his symptoms increased, he was brought to the hospital at 3 A.M.

Patient is a young man of average build, in great agony, restless and unable to lie in any position for a short time. He is having attacks of severe retching but no vomiting.

His general condition is fairly satisfactory. Pulse 100 P.M. and B.P. 120 mg. Hg systolic and 80 mg. Hg diastolic. There is a swelling in the epigastrium extending to very near the umbilicus and laterally to both the hypochondria. The lower border of the swelling cannot be well defined. Iliac fossae comparatively flat. The swelling is highly tympanitic suggesting a distended stomach.

*Treatment.*—Soap Water enema was given with poor result. Stomach tube could not be passed, inspite of repeated trials with a view to empty the stomach.

Operated under spinal planocain anaesthesia 1%, 8 c.c. Median Supra umbilical incision was made. On opening the peritoneal cavity, a highly distended and congested stomach covered with a thin layer of

omentum, occupied the entire abdominal wound. Inspection of the rest of the abdomen was impossible. The stomach was punctured with a sterile needle, after protecting the rest of the area, when a lot of gas escaped. The puncture was closed with a double row of purest ring sutures. The distension having been greatly reduced, a careful inspection showed that the greater curvature of the stomach was twisted on its long axis and lying in the region of the porta hepatis and extending to the left. The transverse colon was in its normal position. The stomach was gently untwisted, when it was seen that the area of the stomach lying in contact with the anterior abdominal wall, where the puncture was done, was the cardiac end of the posterior surface of the stomach. The gastro-hepatic omentum was not elongated. The stomach was not fixed. The abdomen was closed in layers without drainage.

48 hours later the patient had slight distension, which subsided, and convalescence was otherwise uneventful.

After complete recovery a barium examination of the stomach showed no abnormality.

### SUMMARY

1. A case of complete volvulus of the organo-axialis type is described.

2. The trial of symptoms, viz., (a) vomiting in the early stages followed by severe retching, (b) rapidly increasing distension in the epigastric and hypochondriac areas, (c) inability to pass a stomach tube, (d) with an acute onset, in a healthy individual is fairly diagnostic of volvulus of the stomach.

3. The mechanism of volvulus of the stomach is discussed.

I am deeply grateful to the Senior Surgeon, Dr. V. V. Monteiro, for kindly permitting me to publish this case. My thanks are also due to Dr. B. N. Balkrishna Rao, Professor of Surgery, for his very valuable guidance and help.

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### HYDATID CYST-THYROID

by D. GOVINDA REDDY, M.D. and M. THANGAVELU, M.B.B.S.,  
*Department of Pathology, Medical College, Madras.*

A Hindu male aged 25, a ryot from Cuddapah District was admitted into the wards of the General Hospital, Madras on 27th December 1945 under Surgeon Dr. B. M. Sundaravadanan, with a swelling of 6 months duration over the region of the left lobe of the thyroid gland extending from the middle line of the neck to the sternomastoid posteriorly and from the

angle of the mandible to the sterno-clavicular joint below. The swelling moved freely with deglutition, presented definite margins, tense, cystic and fluctuant. The trachea was displaced to the right but there was no dysphagia or dyspnoea.

A provisional diagnosis of adenoma of the thyroid was made. During the operation

while incising the capsule, the cyst burst and a pale white membrane slipped out,



Fig. 1. Thyroid gland showing hydatid cyst.

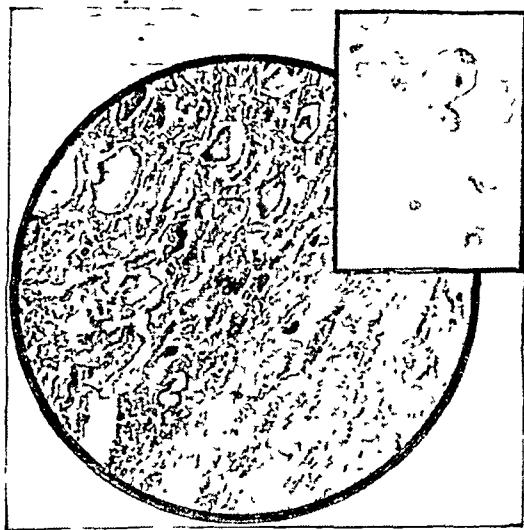


Fig. 2. Photomicrograph showing thyroid structure with ectocyst. In the inset are seen scolices found in the endocyst.

revealing the true nature of the disease as a hydatid cyst (Fig. 1). Blood examination after the operation showed 6% eosinophiles. Casoni's test could not be done for want of hydatid fluid.

*Pathological Report.*—Scrapings from the endocyst showed scolices (Fig. 2 inset).

The ectocyst showed an internal layer of laminated fibrous tissue, an intermediate zone of compressed thyroid acini in various stages of atrophy and peripheral area of normal thyroid gland (Fig. 2).

Patient made an uneventful recovery and was discharged cured on 8th January 1946.

### SUMMARY

1. The incidence of echinococcal cysts in the thyroid gland is rare even in countries where the disease is endemic. Landivar as quoted by Joll<sup>1</sup> has collected thirty-one cases up to 1915. In an exhaustive analysis of these cysts Faust<sup>2</sup> has not mentioned the occurrence specifically in the thyroid, but has stated the incidence as 2.8–4.2% in other organs and this probably includes the incidence in the thyroid.

2. Very few of the recorded cases have been correctly diagnosed before operation. One case was diagnosed by Lannelongue<sup>3</sup> and his diagnosis was based upon abrupt variations in the size of the gland associated with repeated attacks of Urticaria.

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# OSTEOLYTIC SARCOMA OF THE LOWER END OF THE RADIUS

by D. GOVINDA REDDY, M.D. and M. THANGAVELU, M.B.B.S.,

Department of Pathology, Medical College, Madras.

A Hindu male aged about 45 was admitted into the wards of the General Hospital, Madras, in February 1945 under Dr. N. S. Narasimham for a swelling of the lower end of the right fore-arm. He gave a history of trauma preceding the swelling. From the clinical findings and X-ray appearances (Fig. 1) a provisional diagnosis of osteo-



Fig. 1. Roentgenogram taken in February 1945 showing destruction of the cortex of the lower end of the radius. Appearances are not different from those seen in osteoclastoma.

clastoma of the lower end of the radius was made and a biopsy done. The soft tissues showed chronic inflammatory changes, but unfortunately a report on the bone was not made as the bit was misplaced during decalcification. The tumour was irradiated and the patient discharged improved in March 1945.

In November 1945, he was readmitted for a painful rapidly growing tumour. The growth now extended up to the middle of the forearm and was nodular and fluctuant in areas, with stretched skin and prominent

veins. Radiologically destruction of the lower end of the radius (Fig. 2) and secondary deposits in the lungs (Fig. 3)



Fig. 2. Roentgenogram taken nine months later showing complete destruction of the lower end of the radius. The tumour shadow is also seen.

were noticed. Longitudinal section of the limb which was disarticulated at the elbow joint showed the lower end of the radius replaced by a large sized whitish tumour mass. The cystic degeneration with haemorrhages often seen in osteolytic sarcoma was not present. Microscopic examination showed plump malignant spindle cells, round abortive osteoblasts with numerous mitotic figures and tumour giant cells of the opulis type (Fig. 4 and 5).

## REMARKS

The lower end of the radius is a rare site for osteolytic sarcoma, the common situations being the lower end of the femur, the upper end of the tibia and the upper end of the humerus.



It is commonest between the ages of 10, and 20, but may occur at any age.

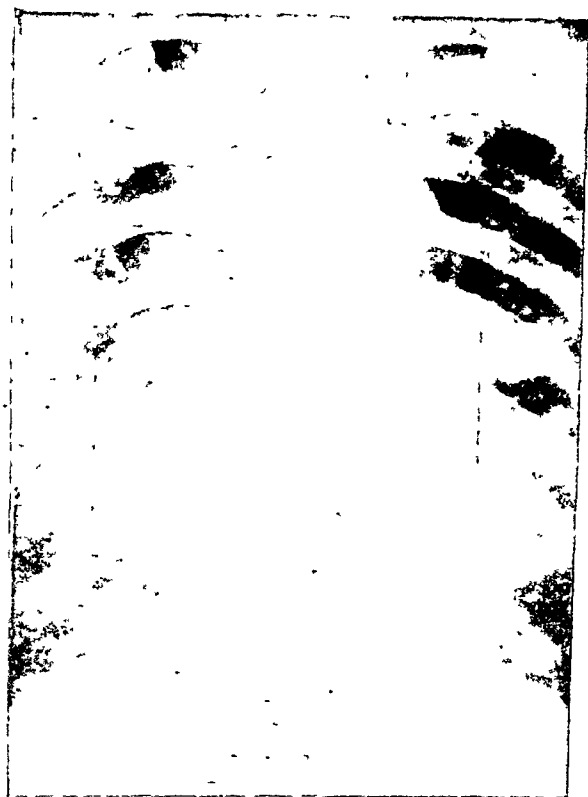


Fig. 3. Skiagram of the chest taken before operation, showing secondaries in the lungs.

In the early stages where there is localised cortical destruction only, osteolytic sarcoma is mistaken for osteoclastoma, since the radiological appearances are almost identical. It may however be remembered that in osteolytic sarcoma there is never bone expansion as in osteoclastoma, but there is destruction of bone including the periosteum.

Since the prognosis and the nature of treatment differ markedly in these two conditions, an early diagnosis is desirable, and that is possible only by a biopsy.

From the recorded cases early amputation or radical resection seems to offer the best chance for a permanent cure. Irradiation must be limited to inoperable cases.

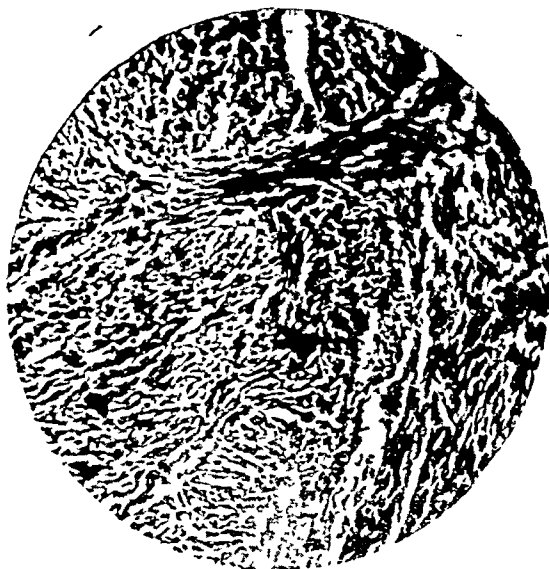


Fig. 4. Low power photomicrograph showing plump spindle cells.

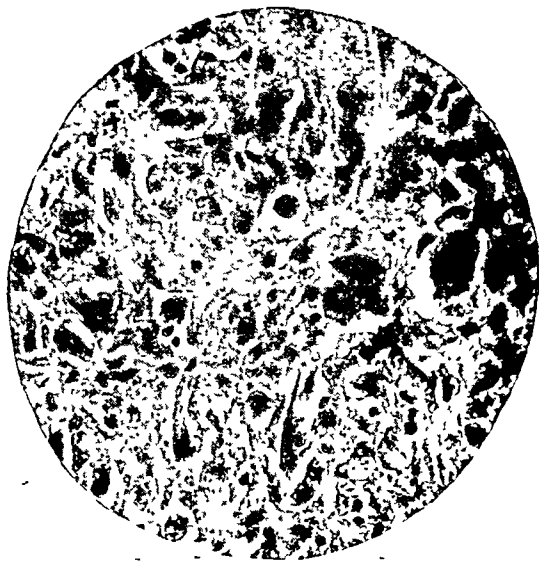


Fig. 5. Medium power photomicrograph showing osteoblasts and osteoclasts with hyperchromatic nuclei and tumour giant cells.

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### The VII Annual Conference

The VII Annual Meeting of the Association of Surgeons of India was held at the Medicine Lecture Hall, Medical College, Mysore, on 27th, 28th and 29th December, 1945 and was, as usual, a great success. Col. V. R. Mirajkar of Lahore presided and Dr. B. N. Balakrishna Rao was the Local Secretary. He was assisted by Dr. M. Athikesavalu, F.R.C.S. (who has now become a member of the Association). They were helped by a Reception Committee under the Chairmanship of Dr. V. V. Monteiro, the Senior Surgeon of the State. All arrangements were made for the comfort of the visiting members and the thanks of the Association are due to the Medical profession of the State for their efforts in making the Session a complete success.

The President and some of the Office-bearers were entertained as State guests.

The Association is particularly grateful to H. H. the Maharajah and his government for the courteous welcome extended to it and for the keen interest which His Highness personally took in the success of the Conference. The Maharajah's Palace and the Gardens at Krishna Raj Sagar were specially illuminated in honour of the visit of the Association.

The formal inauguration of the Conference took place at the Jagan Mohan Palace on 27-12-45 at 9 A.M. In the unavoidable absence, on account of sudden illness, of Dr. T. C. M. Royan, who was to open the Conference, Dr. V. V. Monteiro, the Senior Surgeon of the State, declared the Conference open and read out the inaugural address by Dr. Royan and a message from H. H. The Maharajah of Mysore.

### INAUGURAL ADDRESS AND THE MESSAGE

Ladies and Gentlemen,

It is my great privilege this morning to convey a message from His Highness the Maharaja of Mysore to the delegates and members of the Association of Surgeons of India. The message runs:

### MESSAGE

*"I have great pleasure in welcoming to Mysore the Members of the Association of the Surgeons of India to their Seventh Annual Conference. I hope the members will find their brief stay in this City, pleasant and interesting.*

Consisting, as it does, of eminent Surgeons from all parts of India, the Conference of the Association will provide valuable opportunities for exchange of ideas on the science and art of Surgery. This is particularly important at the present moment when the rapid progress in the sphere of Surgical procedures made during the war has to be assessed, and I have no doubt this will form a great part of your deliberations at the Conference.

I am glad to see that a full consideration and discussion of these and other matters is greatly helped by your practice of choosing subjects two years in advance and that the monthly journal of the Association serves a useful purpose in making the results of your discussions available to a wider circle.

*I wish the Conference success in its proceedings."*

To this message I wish to add a hearty welcome to you on behalf of His Highness's Government and the people of Mysore.

I shall not attempt the difficult task of outlining the nature or the scope of your deliberations or of indicating the value of their outcome. But of this I am sure that our own Surgeons in Mysore will feel all the keener and better for the stimulating contact they have had with great minds during this Conference, and our young men of the University Medical College will have throughout their future professional careers, the benefit of the inspiration that your visit to this place has imparted. It is my hope too that this occasion will offer increased opportunities for Surgeons from different parts of this great country to know one another better and to exchange thoughts pertaining to matters of Surgical experience.

This will, I believe, be the first Conference of Surgeons in India after the cessation of the War; and if one considers the momentous discoveries made under the compelling urge of war in the nature of radio electricity, nuclear physics and allied sciences, one cannot resist the feeling that this Conference of distinguished and representative Surgeons of India at Mysore marks the beginning of a new era in the advancement of the art of Surgery in India.

Ladies and Gentlemen, many of you have come here from distant places at very great personal inconvenience and it is my earnest hope that you will feel yourselves at home and enjoy your visit. This beautiful City and its neighbourhood abound in places of historical and cultural interest and I trust that in the midst of your labours you will find time to include some of these in your itinerary.

### PRESIDENTIAL ADDRESS

by COL. V. R. MIRAJKAR

I am fully conscious of the signal honour you have conferred on me in placing me at the head of your Annual deliberations this year. My only fear is that I may fall short of your expectations and so would ask you to bear with my shortcomings in the same spirit which prompted you in your selection of me.

We have passed through very difficult times these last four years of the devastating war. Even then our enthusiasm for our work and the love and interest in our association has survived. If we look back and consider these difficulties, it appears wonderful and surprising how every year our members have surmounted them and travelled far and near to gather together to show the spirit of professional brotherhood and keenness in their work which is a living thing among them.

So far in our annual Conferences we have dealt with a variety of subjects in the elucidation of which experience and light have been thrown lucidly and I can say that we are definitely much benefitted. At the present Session, among the subjects to be discussed, I am confident you will find important topics which require exchange of

views from members whose experience is valued very highly.

Apart from this line of activity, we have to look farther and extend the usefulness of our Association which will influence the scope of our creative force in the advancement of the knowledge to which we are all devoted.

As you are aware, there has been a proposal which had an unanimous approval, that we should form a body, akin to the College of Surgeons in other countries, which will promote, encourage and be the centre of the highest standard of Surgical work in the country. I can visualize almost in the near future, our Association establishing a Post-Graduate Teaching Hospital somewhere in an area easily and equally accessible to all parts of the country, where research work, specialization and refresher courses for post-graduates will form the chief features.

The necessity for such an institution is keenly felt by everybody and we must take the lead to create such a centre in the very near future. This will be a centre maintained by public benefactions, where research scholars, young enthusiasts wishing to find opportunities to specialize themselves in particular branches of surgery, practitioners who wish to refresh themselves every few years and keep abreast of all advances in our science will find scope to attain their ambitions and desires, and also where specialists from different parts of the country can meet one another to demonstrate their methods and review their work with one another.

In addition to the above Central body we must make it possible to have in each province a Centre affiliated to the mother unit at the Centre. It is an ambitious scheme that I am placing before you, but if you begin to consider it carefully, seriously and dispassionately, it is not beyond the possibilities of achievement.

The crux of the above problem is finance, but in these days of enlightened thought, people with money will come forward cheerfully when they realise the importance of the work and the benefit that it will confer on humanity. I should not be surprised if our professional brethren, who have done a lifetime's valuable work and the same has been blessed with financial reward, come forward to initiate this project by their contributions. I would therefore commend this project to your business deliberations and suggest that a definite step be taken at this session to develop it.

I may be permitted to dilate on this subject a little further in order to impress on you the need for such Post-Graduate Training Centres in our country.

As compared to our population, the number of qualified medical men available is proportionately very few, but still fewer are the specialists in

different branches of surgery. The Medical profession is not static though the various medical societies, local bodies and finally through the Government, our Association should sponsor various plans to meet the cost of medical care, and to ensure the best care and treatment for the patient. For this purpose, it is high time we recommend to the Government to introduce the Insurance scheme for the care of the sick, it is in vogue in other countries like England and the United States.

Just as we have been educated to buy insurance against all sorts of hazards, so too the public can be educated to purchase health and Hospital Insurance. The privilege to do this is the privilege of every citizen. The bureaucracy even with increasing taxes cannot do it better.

In order to meet this demand, we must have enough number of qualified Doctors and also specialists in various branches of medicine and Surgery. To produce better type of Doctors, we must revise the curriculum of medical education, internship and residentship. Marked expansion of educational facilities will be required. This responsibility rests with the medical profession, medical colleges, and hospitals.

The need for teachers is obvious if this new programme is to be carried out and therefore enough attention should be given to train a sufficient number of teachers to carry out these teaching programmes. A survey should be made of the present facilities, their expansion and possibilities of new facilities.

One word as regards Specialists. Whether or not we practice a Surgical speciality. I regard general surgery as a speciality—the need for broad training in the fundamentals is necessary. I am afraid this is often neglected. I am amazed at the number of students who are about to be graduated, having no conception of writing a good history or carrying out a good physical examination. It is evident that the teaching of these subjects needs a new appraisal. The ease with which a history or physical examination is glossed over and the rapidity with which they reach for laboratory aids is astounding. At times, one wonders whether the present day Clinician has lost his powers of observation and teaching. The over-emphasis on the laboratory side rather than the Clinical side is striking. The fear to make a diagnosis of Renal Stone because the X-ray is negative, the timidity to make a diagnosis of Pott's or Colles' Fracture because there is no X-ray, all causes one to wonder. A case of Tabes with cardinal signs receives no diagnosis until the Wasserman report is at hand. We should teach our young men to make a diagnosis without resorting to all sorts of tests and then to verify the diagnosis with laboratory tests indicated.

History-taking seems to be almost a lost art as is physical diagnosis. Whether we practice general

surgery or one or two surgical specialities, one must look at the patient as a whole, that means, each patient should be viewed as a medical problem, one who may require some type of Surgical treatment.

The practice of medicine tends more and more towards preventive medicine. The Surgeon and the surgical specialist also practice preventive surgery. The importance of the pre-operative preparation of the patient preliminary administration of Iodine to a Goitre patient, the choice of one of the many forms of anaesthesia, the pre-operative transfusion of blood, use of sulphur drugs in the abdominal cavity to prevent peritonitis, use of sulphur drugs and penicillin before extraction of infected teeth, certainly constitute preventive measures.

The value of blood banks has established itself. The life-saving feats of blood banks will soon lead to the establishment of other banks, such as the bank for dehydrated nerves, cartilage bank, eye bank, and bank for frozen veins. The frozen veins have proved their worth in the North-African campaign in this War.

Now a few words about Hospitals, their location and their utility. A century ago a hospital was the dreary shelter for the destitute; but today it is the brisk shining centre of all Society's life-giving and life-saving activities. It is the quick development of medical science that suddenly brought the hospital to this new position, and medicine's newer methods require the use of complicated machinery, expensive facilities and varieties of special skills which could be provided best through an institution such as a hospital. Because the hospital today is tied so closely to medicine, it becomes increasingly important that hospital facilities should be made geographically available to all people. Spotty distribution of hospitals means that many of our rural Indians must go without medical or hospital care. Everyday thousands of sick, and injured people are forced to travel many miles away from their homes for hospitalisation or just to see a doctor.

We know there are hospitals all over India, but there is no complete record of our hospital, whenever one wants to know. In many places, anyone can maintain a few beds, offer haphazard care and call it a hospital. We need to know everything about the hospitals all over the country, their location, ownership, the area they serve, physical structure, bed capacity, equipment, capacity for service, qualification of its personnel, financial condition, educational opportunities and research activities.

As early as possible, we must have a hospital map of India with all the details enumerated above. Any hospital with sufficient number of beds and good medical and surgical staff can be taken on our list and noted for post-graduate study. In my opinion, this is the surest way to facilitate the advancement of post-graduate study.

Medicine is international; if need be, the shortage of our teaching staff can be supplemented by inviting well-known teachers from foreign countries with the distinct understanding that they should train our post-graduates. Probably, you are aware what the status of the United States was as regards Surgery before the first World War. I may say, without offence to anybody, that they were no better than what we were at that time. But you will all agree that America is to-day second to none in the Surgical world. How did she manage it? One of the important ways by which they achieved this was by going round all the medical centres in Europe and inducing well-known and experienced teachers to go to America by paying them handsomely on a contract basis on the one condition that they trained up their young medical graduates. Can't we also do the same? Once we bring our country on the surgical map of the World, we can develop our Surgery by rapid strides. There will be mutual recognition and interchange of our post-graduates with those of other countries. I would like that day to come soon so that post-graduate students from Europe and America may come to our country for study just as we send our students to theirs.

It is upto us through our Association to advance Indian Surgery in as short a period as possible and thereby raise our status in the eyes of the World. Our nation has awakened and we are all clamouring for self-rule. But there is no self-rule without self-price. So let us strive our best to reach the summit, I mean the Surgical summit.

You are all aware that the nursing of our sick and wounded is not at all enviable. Our patients would like to be nursed by Indian Nurses. It is the common experience of everyone of you how our civil hospitals were depleted of nursing staff during these years of War. No doubt a large number of them went out to do their bit on Active Service; but scores of our civilian sick did not have good nursing in spite of the teeming millions of our women-folk. Somehow, our ladies have not yet realised their duty towards the sick in general. Besides, the nursing profession is not given its due sense of dignity and honour. Just as purdah is fast disappearing, so also whatever stigma that is attached to this profession should be eschewed and a certain proportion of our educated girls should be encouraged to take to this profession and they should be made to understand that nursing is in fact a branch of medicine. This will have multifarious advantages, economical, social and philanthropical as well. We as an association should do our best to educate our girls to take keen interest in this noble profession.

Everywhere these days one hears of post-war expansion, i.e., expansion of existing hospitals, and building of new ones. We want to give better facilities and better treatment to our suffering sick

and good nursing goes a long way to achieve this. So I recommend that in conjunction with our post-graduate training centres, there should be up-to-date training centres for nurses. If need be, we can even import some teachers to train our nurses. It is important that our middle and upper class girls are induced to take to this profession. These trained nurses will, apart from being good mothers to their children, will also be a source of guidance to mothers in their neighbourhood. I understand that the Madras University has opened a B.Sc. Course in Nursing, a very commendable step indeed, and I wish other Universities also to copy this great example.

Another important question which I would like to bring before you, though it is not directly connected with the Post-Graduate training scheme, is the great need for encouraging some Industrials to start as early as possible a decent surgical instruments and Surgical equipment manufacturing company, including electrical equipment like Diathermy, etc., so that proper standard types of materials and articles, as good as those manufactured in other countries may be produced in our country. Still more, what is urgently required is a branch of the above concern manufacturing Endoscopic instruments such as Cystoscopes, Gastrosopes, etc. These types of instruments have become a daily necessity and we have always to depend on foreign countries for the supply of these and at the same time, we have to pay through our nose. What is still worse is that whenever any of those instruments go out of order, we have to send them to the manufacturers thousands of miles away and we have to wait for months and months to get them back repaired. How we could be associated with this type of Concern, I leave it to the Business Committee of the Association. All I want to say at this stage is that we must get ourselves interested and get the Concern started at a very early date.

As we all know our Association has started a Research on the classification of malignant Tumours and a request was sent out to promote this by sending sections of tumours with their notes to enable the Committee to carry out this important work. The response, I am afraid, has not been very satisfactory. I mention this so that our members may keep this in mind and help as much as they can. This branch of work will form a very important part in the growth of our projected Post-Graduate College.

The Library Fund again has not grown to any encouraging proportions and when it is remembered that a Library will form an integral part of our proposed College, I am sure its growth will be stimulated by your further help.

I would also request you to utilize the Journal of our Association more freely than you have done so far. We require informative as well as authoritative knowledge of the science to which

our Journal is devoted and we would like our younger members especially to come forward with their views and experiences. The Journal should be a fitting ornament of our Association.

I appeal, on behalf of the Association, to the younger generation, to consider it their duty to take a very keen interest in their association and see it gather strength, so that it, in every sense an authoritative, advisory and educative body, will be in a position to give the required considered opinion to bodies like the All-India Medical Council to all the Universities in India and other Educational institutions interested in teaching Surgery.

Much more so, our Association is the proper one, to which similar associations in other countries to approach to, whenever they want to know anything about Surgery in India.

Gentlemen, I am so sorry that Dr. Royan, the Hon'ble Minister for Education and Public Health, who was to inaugurate our Session, is suddenly taken ill and Dr. V. V. Monteiro, the Senior Surgeon of the State, is acting in his place. We all request Dr. Monteiro to convey the feelings of sympathies of the House to Dr. Royan and we all pray that he will soon be well and fit to resume responsible duties. Our Association is deeply grateful to Dr. Monteiro for inaugurating the VII Annual Meeting and request that our deep obligations be conveyed to His Highness The Maharaja of Mysore for the instructive message that he has sent to us, at this hour and also we are keenly grateful to His Highness for making it possible for us all to meet in this beautiful town of His (Mysore) and giving us all, coming from far and near, the opportunity to meet and enjoy his hospitality. Please assure His Highness that we will remember this great occasion for a long time to come.

If it may please His Highness, our great request of our Association is that he should also take a keen interest in our Association as he does in other spheres!

It will be a boon to our country if His Highness can make it possible to create a Post-graduate Medical Centre in his Capital, where Research Surgery of the highest standard can be performed, so that it becomes a Centre of great learning, where students from all parts of India and the World may come and learn.

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The first Governing Body meeting was held at the Medical College, Mysore at 10-30 A.M. on 27-12-45 under the Presidentship of Col. V. R. Mirajkar. The Secretary read the minutes of the last two Governing Body Meetings and they were passed. 16 new members who were proposed during the year 1945 were admitted. It was decided to correspond with the Executive members of

other Associations in foreign countries in order to ascertain ways and means of closer co-operation with each other and also to exchange copies of publications.

It was proposed to appoint a Sub-Committee to go through and if necessary suggest amendments and additions to the Rules and Regulations of the Association. The Committee, it was resolved, to be convened in Bombay by Drs. S. R. Joglekar, A. V. Baliga and A. E. De'Sa, with Dr. S. R. Joglekar as Convener. The Sub-Committee should send its report to the Secretary before 31st March, 1946. Admission of Hony. members shall also be considered by this Sub-committee.

It was resolved to award to Dr. V. Ramachandra Rao, the prize for his Essay on 'Infections of the Foot' and the prize was to be awarded at the Annual General Body Meeting on 29-12-45. The subject for the next prize Essay, it was decided, should be 'Surgical Aspects of Amoebiasis'.

A committee consisting of Drs. M. G. Kini, B. M. Sundaravadanan and C. P. V. Menon was formed to go further into the matter of a Library and Building for the Association.

The time and place of the next annual meeting was discussed and the invitation from Lucknow was accepted.

Discussion on the three main subjects fixed for this year were held in the afternoons.

Dr. B. N. Balakrishna Rao delivered a lecture on 'Psycho-Surgery' on the 29th of December after he had demonstrated the operation of pre-frontal leucotomy in the cadaver.

Visits to the Tuberculosis and other Hospitals in the city had been arranged. Excursions to the Chamundi Hills, the Guest Palace and other places of interest like the Palace, Lalitha Mahal, etc., were also arranged.

The usual Dinner of the Association was held at Hotel Krishnarajasagar.

### The Annual General Body Meeting

The 7th Annual General Body meeting was held at 4-15 p.m. on 29-12-45 at the Medical College, Mysore, with the President Col. V. R. Mirajkar in the Chair. More than 65 members were present.

A condolence resolution touching the untimely demise of Dr. T. O. Shah, was passed all the members standing.

The Secretary then read the minutes of the last General Body meeting and the annual report for the year ending 31-12-45 and they were unanimously passed.

The Meeting discussed the question of the publication of a Text Book by the Association and after a long discussion, arrived at the conclusion that the idea may be dropped.



# THE INDIAN JOURNAL OF SURGERY

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## TRAUMATIC SURGERY OF THE SKULL

BY

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No discussion of traumatic surgery of the skull can be undertaken without a consideration of the essential anatomical, physiological and pathological factors concerned. Even a short study of the evolution of the treatment of head injuries reveals this very significant fact that errors in treatment were due to a non-appreciation of the pathology underlying such injuries. Even as early as 1811 John Abernethy protested against "the propriety and necessity of trephining the cranium under various circumstances consequent upon injuries of the head" even though this method of treatment had the sanction of the Academy of Surgery in France and Mr. Percival Pott in England. Thus it was again, that terms like concussion, commotio cerebri, contusion, compression came into usage without an adequate scientific basis. Even as late as 1902 Cushing's experiments on increased intracranial tension where slowing of the pulse and an increase of blood pressure were noted to occur simultaneously, were wrongly considered as an indispensable sign of increased intracranial pressure and the operation of trephining, under the name of subtemporal decompression, was much abused. No originality is claimed for this paper. It is merely a humble effort to present the subject for purposes of a discussion. Such a discussion may help to reduce the total mortality of head injuries from a high figure to somewhere between 17% and 20%.

### ANATOMICAL FACTORS.

The various articulations between the head and the cervical vertebra ensure a certain mobility to the head which serves to protect

it from injuries. As the head moves in the line of the impact its severity is modified. However, it is important to realise that any violent injury to the head which lifts it away from the body may stretch the components of the brachial plexus and cause paresis of muscles of the upper extremity which may complicate the neurological picture produced by an injury to the intracranial contents.

The frontal and the temporal bones are particularly important, the former because of the association of the air sinuses and the latter because of the petrous portion and its contents and the middle meningeal vessels.

The mechanism of injury involved in penetrating and gun shot wounds is omitted from this discussion because of lack of personal experience in these types of injuries.

Fracture of the skull may be produced as the result of (1) a local deformation, (2) general deformation, (3) or both.

- (1) **Local deformation:**—Fractures produced by local deformation are comparable to a rupture resulting in a green bough as it is bent over one's knee. The rupture always occurs on the side or the convexity. The vault of the skull is elastic and as a direct blow is delivered on a localised area of the skull, the particular area is so indented or deformed that the convex external surface becomes concave and the concave internal surface becomes convex. Should a fracture now occur it will be on the inner surface. Thus it is that the inner table of the cranial bones gets fractured more often than the outer. At the periphery of the indent-

\*A Paper read at the VIIth Annual Conference of the Association of Surgeons of India in December 1945 at Mysore.



ation fracture occurs in the outer table because of the convexity produced.

Massive depressed fractures caused by large objects travelling at great speed are usually fatal.

- (2) Fractures due to general deformation may be brought about as the result of
  - (a) the head being crushed between two external objects.
  - (b) the head being crushed between an external object and the spinal column, or
  - (c) the head striking against a hard substance when a man is knocked down as in a street accident.

The skull is composed of the vault and the base. The bones composing the vault are more elastic than bones forming the base. Within limits, the skull can withstand a general deformation. A compression of the skull in one direction will cause its bulging in the opposite direction which may result in a bursting fracture. Naturally such a crack will occur at the junction of the elastic vault with the non-elastic base and then spread in different directions. The ultimate fracture pattern will be influenced by the nature of the accident and by certain anatomical peculiarities of the skull.

When the head, in consequence of an injury, is pressed against the spine, the thrust travels through the occipital condyles. Apart from a fracture produced by bursting as described above, a circular fracture around the occipital condyles, due to local deformation, may detach the basiocciput producing a ring fracture of the basiocciput. Fracture patterns are also influenced by the fact that the skull is composed of certain relatively thin plates of bone enclosed within thick buttresses.

Fracture patterns in the base of the skull are influenced by the petrous buttresses and the thickened edges of the sphenoidal wings so that the fracture lines often converge to the pituitary fossa. Yet it is surprising that injuries to the cavernous sinus are not common. Arterio venous aneurism between the carotid artery and the cavernous sinus is rare. Only two cases have come under personal observation. The base of the skull is weakened by numerous foramina and fracture lines

frequently open into these foramina. The sphenoidal fissure is frequently affected. The weakest part of the petrous bone is situated externally where it encloses the middle ear. Fractures through this locality are not uncommon. But only an overwhelming violence will cause a fracture through the middle of the petrous bone. Such a fracture is generally fatal. The ease with which the cribriform plate is fractured is explained by the force being transmitted to it through the internal angular process.

In road accidents in particular, the head may be struck more than once in different directions and it would not be possible to reconstruct an accident from a study of the fracture pattern. This point is of peculiar medico-legal importance.

The dura is more closely adherent to the bone in childhood and in old age, than in adult life. Tears in the dura are therefore associated with fractures of the skull at these extremes of age. It is for the same reason that epidural haematomas resulting from middle meningeal haemorrhage are not found at these ages. In the case of a child, a tear in the dura mater associated with a linear fracture of the skull, acts as a safety valve and permits intra-dural haemorrhage to escape outwards and form a so-called safety valve haematoma underneath the galea. The same mechanism permits the cerebro-spinal fluid to escape under the scalp coverings to form a traumatic meningocele.

The dura is firmly adherent to the bone at the foramina where the vessels and the nerves enter or leave the cranial cavity and take with them a covering of dura matter. Hence fractures through the foramina will tear the dura as also injure the vessels or the nerves at the same time.

The dural partitions within the skull—the falx and the tentoria—are so rigid as to act virtually as bony partitions in respect of all acute traumatic lesions. However, the partitions behave differently in the face of slowly expanding intracranial lesions.

There is only a potential space between the dura and the arachnoid mater. Hence a collection of blood under the dura can occur under three conditions. There may be a tear

in the dural sinus, or a rupture of a cortical vein with a tear in the arachnoid mater or very commonly a rupture of the short communicating veins which drain the cortical vessels into the dural sinuses. These veins have fragile walls. At one end they are anchored to the longitudinal sinus into which they open. For a short distance from this end they are firmly adherent to the dura mater. The rest of their course through the subarachnoid space is short and straight. The mechanism of rupture of these veins will be referred to a little later.

Fractures of the skull however acquire their real importance because of associated complications such as injury of the air sinuses, blood vessels, nerves, meningeal coverings and brain itself. In non-penetrating injuries of the head, the brain and the lepto-meninges may be injured either as the result of local deformation from a depressed fracture or as the result of the movements of the brain within the cranial cavity as the head is thrown violently into motion and subsequently brought to rest.

The movements of the brain within the skull operate in different ways to produce several complications.

(1) When a man is thrown on his head against a resisting surface, the skull and the brain do not travel with the same velocity because of the difference in their densities. In the initial movement the skull travels faster than the brain. There is a distinct lag of the brain in relation to the skull. Thus when the skull strikes a hard surface and has its movement suddenly arrested in consequence, the brain because of its initial lag still continues to travel in the original direction and slaps itself against certain segments of the skull or the surfaces or the edges of the rigid dural septa. Therefore depending on the axis along which the brain moves all combinations of surface injuries may occur.

(2) At the pole opposite to the site of the impact the conditions are different. As the skull comes to rest, the brain because of its initial lag continues to move in the original direction away

from the skull. A space is thus produced between the skull and the brain. Momentarily a negative pressure is produced in this pocket. The suction so produced may be sufficient to produce a rupture of the surface vessels. Similar pockets of negative pressure may be produced between the dural septum and the brain in the other cerebral hemisphere. These injuries away from the side of the impact constitute a part of the so called *contre coup* damage.

(3) The sliding movement imparted to the brain as described already can cause a rupture of the tethering veins which drain the cortical veins into the longitudinal sinus. These veins have fragile walls. At one end they are anchored to the longitudinal sinus into which they open. For a short distance from the end they are firmly adherent to the dura mater. But the rest of their course through the subarachnoid space is short and straight. Hence in sliding movements of the brain in an antero-posterior direction, as in falls on the forehead or the back of the head, they are most liable to rupture. It is easy to see how such haemorrhages are often bilateral. The accumulating blood tends to gravitate to the most dependant part of the subdural space as determined by the position of the head as the patient lies in bed. The accumulation usually occurs in greatest bulk over the surfaces of the temporal lobes.

(4) The large basal arteries because of their tortuosity and thickness of walls escape injuries due to sliding action of the brain within the cranial cavity. Different is the case with the straight basilar artery and its short symmetrical branches coming out at right angles from the parent artery. A tearing of these small branches produce symmetrical medullary haemorrhages in fatal cases.

(5) The same gliding movement can account for the avulsion of cranial nerves.

(6) The brain is not of uniform density. The cerebellum is lighter than the

cerebrum and hence it suffers less because of lessened momentum. The density of the cortex and the pons is not the same. Each hemisphere is separate from the other being connected through the corpus callosum and the commissures. The cerebellum is similarly connected with the cerebral hemispheres through narrow pathways. Hence the different parts of the brain can move simultaneously or independently of each other and a kind of gliding action can occur between two adjacent components of different densities with the result that the connecting pathways may easily be bent, stretched or torn. These gliding movements within the brain itself may also cause tearing of blood vessels with resulting punctate haemorrhages. Had there been no cerebro-spinal fluid to act as a water cushion the damage produced by these gliding movements would have been greatly accentuated. Thus in all closed injuries of the head, the brain is subjected to various distorting forces which may produce different types of pathological lesions.

Before embarking on the pathology underlying different types of brain injuries it is advisable to consider briefly a few points in the physiology of circulation of (a) arterial and venous blood, (b) the cerebro-spinal fluid, and (c) perivascular and perineuronal or tissue fluids.

It is to be remembered that the brain is enclosed in a rigid casing. The compressible components are the three fluids referred to above and the brain substance. Normal physiology depends on a proper balance being maintained among the four components. Any departure from this balance constitutes pathology.

Despite the popular belief it must be pointed out, that there is a fairly free collateral circulation among the different arterial branches and that these are not end arteries. The six branches arising from the Circle of Willis are distributed all over the cerebral hemispheres. Some of these supply the basal ganglia, the choroid plexus and to a certain extent the deep white matter. Most of the branches, however, soon reach the surface of the cortex and sub-

cortical white matter. These branches keep on sub-dividing to form the capillary bed. The arterioles and capillaries have a wide anastomosis with branches from other arterioles and even meet and join with the branches of the deep vessels that have come up through the white matter and even the ganglia. Further it has been definitely established that cerebral arterioles have a sympathetic nerve supply. Recently a vaso-dilator mechanism of the cerebral arterioles has been demonstrated.

There is also a chemical control of the vessels. Increase of  $\text{CO}_2$  content of the blood produces a local vaso-dilatation. Histamine, ergotamine tartarate, and amyl nitrite also produce a dilation of the cerebral arterioles.

The amount of blood within the intracranial cavity is dependent on the size of the vascular bed. As all the existing capillaries are not functioning at any given moment the size of the vascular bed will vary. The lumen of the arteries and their branches is smaller than that of the corresponding veins and their corresponding tributaries. Therefore the total arterial bed is smaller than the total venous bed. As the veins are more collapsible than the arteries any slow expanding lesion in the cranium will first affect the venous bed by compressing it. As the venous bed is larger than the arterial bed no demonstrable harm ensues until such time as the compressed venous bed remains equal to the arterial bed. If any further compression of the venous bed ensues, venous congestion will be produced. The rise of venous pressure attendant on compression of the venous bed will interfere with the absorption of the cerebro-spinal fluid. This will lead to an increase in the quantity of the cerebro-spinal fluid as also an increase in its pressure within the cranial cavity. Naturally this must lead to an apparent increase in the volume of the brain. This will be compensated within limits by the cerebro-spinal fluid being driven from the cranial cavity into the spinal dural coverings and being absorbed from venous channels along the spinal nerves. There is however a limit to such absorption and resulting accommodation to increased brain volume. As the skull is a rigid structure any further increase in the volume of the brain will cause further compression of the thin walled veins with resulting further increase in venous pressure. Thus a vicious circle is set up.

As already stated, the total volume of blood within the brain depends upon the extent of the vascular bed. The size of the vascular bed depends on the number of functioning capillaries. As all the existing capillaries do not function in any tissue all the time it follows that the total amount of blood volume must vary. Should therefore all the capillaries of the brain start to function and should they also dilate at the same time it is easy to see what a large amount of blood will be trapped in the brain capillaries causing an increase in brain volume with the attendant train of events.

It is interesting to note that in the cellular layers of the cortex, the capillaries are extremely numerous and can be seen to run very close to each individual cell. As established by careful histological studies there are approximately 1000 m.m. of capillary length in 1 cubic m.m. of gray matter and about 200 m.m. in the same amount of white matter. The role of the capillaries in the production of certain pathological pictures has not been fully appreciated.

The circulation of the cerebro-spinal fluid has been called the third circulation by Cushing. There is no central pump, yet the circulation of the cerebro-spinal fluid is dependant on the integrity of the blood circulation in so far as the production and absorption of the cerebro-spinal fluid is concerned. The pressure of the cerebro-spinal fluid is lower than the arterial capillary pressure, but greater than venous pressure in the dural sinus. Cerebro-spinal fluid is manufactured from the choroid plexus within the ventricles. It is either a transudate or an active secretion. Any drop in the arterial pressure will diminish production at the choroid plexus end and any increase in the venous pressure will prevent absorption. Absorption occurs at the venous end mainly through the medium of the Pachionian bodies. A certain amount of absorption occurs in the spinal column through venous channels along the spinal nerves. Should the Pachionian bodies be clogged by the entanglement of red blood corpuscles etc., as does happen in cases of cerebral injuries, absorption will be interfered with and the cerebro-spinal fluid pressure rise and in its turn produce a vicious circle by increasing the brain volume and thus compressing the venous bed. The normal pressure of

the cerebro-spinal fluid as measured by a lumbar puncture in the horizontal position is between 50—150 m.m. of water. In the erect posture the pressure is higher. The pressure of the cerebro-spinal fluid is mainly influenced by the increase in intracranial venous pressure. This is the basis of Queckensdt's test.

**THE TISSUE FLUID:**—All large and small arteries and veins contained within the brain are enclosed in a perivascular space. This space demonstrable in the larger vessels is not discernible in the capillaries. However the arrangement of the supporting glial tissues about the smaller vessels is such as to create a potential space. When this space is distended as in a case of generalised oedema of the brain, it is seen to be continuous with the perivascular space around the larger vessels. Further the perineural and pericellular spaces have been seen to be continuous with the pericapillary spaces. The fluid that is present in these perivascular and perineural spaces is known as tissue fluid. This fluid escaping from the pericellular spaces, passes into the ill defined peri-capillary spaces and thence into the perivascular region. A part of the flow continues towards the surface of the brain and finally empties into the subarachnoid space. Thus it must be remembered that the cerebro-spinal fluid is not a pure product of the Choroid plexus but it also receives a small amount of the tissue fluid. It must not be assumed that all the tissue fluid escapes into the subarachnoid space. The formation and absorption of the tissue fluid depends upon the hydrostatic pressure at the arterial and venous end of the capillaries and upon the osmotic pressure between the blood and the tissue fluid. Normally the arterial capillary pressure is 33 m.m. of Hg. and the venous capillary pressure is 16 m.m. Hg. Hence the flow of tissue fluid is from the arterial capillaries to the extra cellular spaces and from there into venous capillaries and partly into subarachnoid space. The osmotic pressure in the arterial capillaries is 25 m.m. of Hg. and 26 m.m. Hg. in the venous capillaries. Normally the osmotic pressure of the extra cellular fluid is less than the osmotic pressure of the blood. Hence normally the flow of the tissue fluid is from the tissue spaces into the blood stream. However should the capillaries be damaged and their permeability altered permitting the escape of protein molecules into the tissue fluid, the osmotic tension

of the tissue fluid would rise and more fluid would be attracted into the tissue spaces and oedema would result, and the tissues become water-logged. This oedema or water-logging will be accentuated by any rise in the venous pressure which will interfere with the absorption of the tissue fluid. This is the basis of the all important phenomenon of oedema of the brain. The increase which the tissue fluid undergoes during this pathological process is phenomenal. This increase also leads to an increase in the brain volume. This causes therefore a further compression of soft walled veins and the venous pressure rises abnormally high and the vicious circle already referred to is further accentuated.

Cannon has shown that the tissues deprived of oxygen take up fluid and swell. When damming up of venous blood occurs, oxygenation is naturally diminished. Now if it is remembered that the pericellular and perivascular spaces are co-extensive with the arterial and venous channels it is easy to comprehend to what extent fluid can accumulate in these spaces and to what extent oedema can ensue and to what extent intracranial tension would rise with all its deleterious effects. Thus the delicate balance between the cerebro-spinal fluid, the blood, the tissue fluids and the nervous tissue ensures the normal functioning of the brain. Any departure from the normal however produced constitutes the prime basis of pathological processes in the brain. It is well to remember that oedema can be local or generalised.

In all cases of head injury the three demonstrable primary pathological conditions produced are:—(1) Contusion, (2) Laceration, (3) Neuronal damage either anatomical or physiological or both.

All other phenomena such as massive haemorrhages, oedema, herniation are secondary. However Brock states that cerebral oedema has been found in patients killed instantly.

(1) Contusions are very small areas where solution of continuity of brain tissue has occurred. These may be superficial or deep. In each such area there is a haemorrhage of a punctate nature. If the contusion is superficial, the pia mater is not torn and the affected area looks reddish blue in colour. Such areas

may be single or multiple. Gliding movements of the brain within the cranial cavity during a trauma are responsible for these contusions. As the pia is not torn, naturally no blood will be found on lumbar puncture in the cerebro-spinal fluid. The final recovery may be complete or leave behind some residual focal symptoms depending upon the extent of the damage done to the affected area.

(2) Lacerations are gross solutions of continuity in which the pia is torn. Hence a lumbar puncture will show the presence of blood in the cerebro-spinal fluid. The arachnoid may be torn also and a subdural collection of blood or cerebro-spinal fluid may occur. Such lacerations are often found during the course of an operation. Naturally final recovery is more apt to leave behind residual focal symptoms. All cases of contusions and lacerations are not fatal.

In about 7% of the fatal cases symmetrical haemorrhages into the pons and medulla oblongata occur. The basilar artery supplies the pons by branches which leave the main trunk at right angles. With the stretching of the cerebrum from the brain stem which is relatively more fixed, the main vessel is stretched and the symmetrical branches are torn. Such haemorrhages may be the only pathological lesion in fatal cases.

The area of contusions and lacerations undergo healing. The repair may be so complete as to leave behind hardly any trace. On the other hand the repair may be such as to produce definite sequelae, some of which may require surgical interference at a later date for their eradication.

It is not profitable to discuss the exact method of repair which involves the aid of Astrocytes and Oligodendrocytes of ectodermal origin and the microglial cells of mesodermal origin. It is best to enumerate the different end results of healing.

(1) A small contusion heals by a glial scar. The dead tissue in the contused area liquifies. This product of disintegration is removed by the oligodendrocytes which are phagocytic in action. The astrocytes now proliferate in this area producing a typical glial scar. No mesodermal cells take any part here.

(2) Large surface lacerations involve the activity of cells of both ectodermal and mesodermal origin. The mesodermal cells are derived from the neighbouring blood vessels. The scar tissue is therefore partly glial and partly mesodermal in origin. Such scars are adherent to the leptomeninges and the dura mater.

(3) In areas where loss of cerebral tissue is great, nature fills up the space by creation of a cyst lined by fibrous tissue. The fluid is Xanthochromic in nature.

(4) Instead of a scar, degenerative changes of an extensive type may occur producing various kinds of neurological disorders. Thus progressive softening of the brain tissue may result in delayed cerebral haemorrhage first described by Bollinger. Repeated small traumas received by second rate boxers who frequently go down for a count of ten produce a condition known in the boxing fraternity as "punch drunk."

In the syphilitics and the arterio-sclerotics a degenerative encephalopathy may be precipitated or aggravated if already existing. In estimating the after effects of a head injury both these factors must be taken into account.

(5) Associated with a primary injury may be a thrombosis of a vessel which will bring about cortical atrophy. The thinness of the cortex so produced may be compensated by a dilatation of one of the ventricles which is revealed by an encephalographic study.

Sometimes a cavity so produced communicates with the ventricle through a narrow channel.

(6) On rare occasions and particularly in children, a fracture of the vault associated with a tear in the dura and arachnoid mater leads to an escape of the cerebro-spinal fluid in the sub-galeal space resulting in the formation of a traumatic meningocele.

(7) Large areas of bone may disappear as the result of malacia or absorption of bone following trauma.

(8) Neuronal damage. Unconsciousness which almost invariably accompanies major injuries to the head cannot be explained on the basis of contusions and lacerations already discussed. These areas only represent focal mischief. To explain unconsciousness it is essential to assume that some neuronal damage is inflicted. The exact nature of such a change in the neurons is under dispute.

Wilfred Trotter formulated a theory which was based on the work of Kocher. Acute distortion of the skull will cause a partial driving out of cerebro-spinal fluid into the spinal sub-arachnoidal space, and a marked compression of not only the veins but also the arteries of the brain. The compression of the cerebral arteries leads to anaemia of the brain resulting in unconsciousness and paralysis of different centres situated at different levels. Thus the paralysis of the oculo-motor centre results in a wide dilatation of the pupils. The paralysis of the vaso motor centre and the cardio-inhibitory centre will produce a low blood pressure and a rapid running pulse. Should the anaemia be of such a profound nature as to continue beyond three minutes death will ensue. However in the majority of cases the anaemia is of a much shorter duration and with the consequent recovery of circulation, a rapid improvement in the neurological condition of the patient takes place.

In this connection it is interesting to refer to some findings in an experimental work undertaken by me and my colleague Dr Ginde. Working on anaesthetised dogs it was found that every blow on the head was promptly followed by a drop in the blood pressure recovery from which was very rapid. A dog's skull is very thick and does not show any evidence of a fracture even after infliction of severe blows. But each blow is accompanied by a marked fall of blood pressure. It seems reasonable to assume that in the human being too, an injury to the head produces such a profound drop of blood pressure as to produce anaemia of the brain and unconsciousness. Our experimental work in this connection is incomplete.

For those cases where recovery of consciousness occurs within a few minutes this theory may be adequate. It does not satisfactorily explain those cases where unconsciousness is much more prolonged and where recovery is of a halting nature.

As Trotter's explanation does not seem to be applicable in all cases it is necessary to formulate another theory which proposes that traumatic unconsciousness is due to a widespread neuronal damage either to the cortical cells or to the sub-cortical pathways. This damage may be physiological, or anatomical or both.

There is no real seat of consciousness in the brain. The proper functioning of all parts of the cortex and the sub-cortical pathways is responsible for the state of consciousness.

Consciousness is the sum total of our awareness to our environments in terms of time and space. Awareness or consciousness is the result of the harmonious perception of various peripheral stimuli—visual, auditory, tactile, labyrinthine, etc., and an adequate and purposeful response to each such stimulus.

The degree of unconsciousness depends on whether there is a total or partial obliteration of the appreciation of such stimuli. Thus in a stage of partial unconsciousness a person may distinguish between light and darkness but may not be able to recognise his surroundings. Even during normal conditions the degree of consciousness may vary. Thus without being personal I may state that my words may be falling on the ears of all but the thoughts of all are not running in the same direction.

It is therefore permissible to assume that in sudden and violent injuries to the head, the sudden movement imparted to the brain causing displacements of hemispheres and the stretching, kinking of the various connections will result in damage to these all important cortical cells where all impulses originate or are finally received or to the axons along which these impulses are conducted. There can be no basic or uniform histo-pathological picture for the condition known clinically as concussion. Presumably both anatomical and physiological injuries occur together. Naturally recovery is relatively rapid where physiological damage preponderates.

The stem forms the pivot round which the movement of the brain occurs. It is comparable to the movement of a fly swapper. Evidently the cortex moves through the largest arc and receives a violent impact and the connecting fibres are stretched, kinked or other-

wise deformed. If the physiological damage is in any sense comparable to a Saturday night palsy, recovery from the effects of trauma would extend over weeks and not hours as so frequently happens.

None of the theories so far given explain the usual picture of a head injury starting with unconsciousness and ending up in a recovery in stages.

I therefore venture to put in a suggestion which occurs to me as a probable explanation of the vague term of concussion.

The initial loss of consciousness may be induced as explained by Trotter. Or else the initial drop in blood pressure after infliction of a head injury, as seen in animal experiments, may produce a momentary ischaemia of the brain which in its turn produces instantaneous unconsciousness. Where recovery is equally rapid one may imagine that the only factor in operation is the sudden ischaemia of the brain.

However in more severe injuries other factors may be coming into play. When we recall that there is a very large capillary bed—1000 m.m. of capillaries in every one cubic m.m. of cortex—we cannot help thinking that the role of the capillaries cannot be ignored.

As the result of trauma to the head there is a generalised trauma to all the structures of the brain. As the result of trauma, histamine or an allied product would be liberated which would produce an enormous vaso dilatation. The hitherto non-functioning capillaries may be opened up. In these dilated capillaries an enormous amount of blood will be trapped. The initial drop in the blood pressure produced by the trauma, associated with the intracranial vaso dilatation materially influences effective intracranial circulation. As the respirations at the time are shallow, sufficiently oxygenated blood will not be available. The lowered  $O_2$  content and the increased  $CO_2$  content will lead to further dilatation of capillaries. The large quantity of blood trapped in these dilated capillaries will lead to an increase of the brain volume. To a certain extent the increased brain volume will find accommodation in the rigid skull case by expulsion of the cerebro-spinal fluid into spinal subarachnoid space. This mechanism is hardly sufficient to meet the situation. The increased volume of

brain therefore causes a compression of the venous bed which accentuates the intracranial pressure by arresting the absorption of the cerebro-spinal fluid and the tissue fluids as already explained. The increased intracranial tension further compresses the venous bed and a vicious circle is set-up resulting in oedema of the brain. The increased CO<sub>2</sub> tension caused by venous congestion and retarded circulation will according to Cannon induce further oedema. However the increasing CO<sub>2</sub> tension has a stimulating effect on the vomiting centre and the respiratory centre and the vaso motor centre. If these centres are not irretrievably damaged the blood pressure will rise, aeration of blood will occur and recovery take place. The dilatation induced in the capillaries by histamine-like products persists for sometime, hence the volume of blood trapped in the capillaries will not be displaced immediately on restoration of a more effective intracranial circulation. Complete recovery in a given part of the brain cannot occur till the vaso dilatation dies down in that part. Naturally recovery will be more rapid where capillaries are fewer as in the medulla and slower where the capillaries are more numerous as in the cortex.

In actual clinical practice we do find that recovery starts at the lowest level and then works up to the higher neurological levels. A natural explanation is thus given to this particular method of recovery. Naturally it will take some time for the final normal balance to be restored to the four components—blood, cerebro-spinal fluid, the tissue fluid and the nerve tissue. To my mind the congestive and ischaemic conditions produced by the increased intracranial tension and oedema are responsible for the physiological neuronal damage either to the cortical cells or to the conducting nerve fibres. Normal nutritional needs of the neurons are not satisfied in respect of oxygenation. The nature of the pathological processes just described is reversible hence a recovery from the damage done is possible. That such an increase of pressure does exist is the experience of several of us who have opened up a skull, on the basis of a massive haemorrhage, and have found a congested brain visibly bulging after incision of the dura in the absence of haemorrhage extra or intra dural. Percival Bailey states that brain volume can increase by 50%. Rowbotham in his splen-

did monograph on acute injuries of the head quotes Winklemann and Eckel from their work on histopathology during early stages of brain trauma to the effect that "the capillaries as well as the venules are congested, which suggest that the vascular changes are the result of active participation of the vessel walls in this state rather than the consequence of pure mechanical obstruction due to increased intracranial pressure."

It may be permissible to state that all injuries of the head will result in a total and spontaneous recovery if that part of the brain which is essential to life is not destroyed and if other retarding factors do not come into operation.

These other factors will be enumerated but not described. These are:—

- (1) Shock Primary  
Secondary
  - Extra dural
  - Acute or Chronic subdural
- (2) Massive haemorrhage
  - Subarachnoidal
  - subpial (contusions)
  - Intra cerebral
  - Intra ventricular
- (3) Collection of C.S.F.  
Subdural hygroma
- (4) Oedema localised  
generalised.
- (5) Hydrocephalus
  - External due to blockage of Pachionian bodies
  - Internal (rare due to a clot in Aqueduct of Sylvius.)
- (6) Herniation of the Brain
  - (a) a basal shift due to herniation of one hemisphere under arch of falx.
  - (b) Tentorial pressure cone.
  - (c) Cerebellar pressure cone.
- (7) Infection
  - Meningitis
  - Encephalitis
  - Brain abscess
- (8) Dehydration Early.  
Late.
  - (a) blood through orifices or under the skin.
  - (b) C.S.F. through orifices or under galea.
  - (c) Air—Surgical emphysema—Aerocele.
  - (d) brain substance.
- (9) Escape of:—
- (10) Injury to cranial nerves.



**CLASSIFICATION OF HEAD INJURIES:—**

A classification based mainly on the anatomical and physiological damage done to the brain is attempted. It is convenient to do so from the diagnostic and therapeutic points of view. Five types of injuries may be described:—

**TYPE (1)**—Injuries where there is only focal mischief to the brain, with or without a fracture of the skull. Unconsciousness may be absent or not noticeable. Such injuries may be brought about by a lathi blow, a tangential bullet wound, a cricket ball (striking the temporal region) or by penetration of skull by a spike with laceration of subjacent cortex.

In such cases the focal mischief is indicated by occurrence of epileptic attacks within the first few hours of the injury. These are probably symptomatic of cortical damage. Other evidences of focal mischief may be a relative weakness of the limbs of one or both sides, defects in visual fields, anosmia, etc. Blows on top of the head may cause paraplegia of both legs as described by Gordon Holmes and is due to thrombosis in the longitudinal sinus.

**TYPE (2)**—Injuries where the underlying lesion is a generalised transient ischaemia of the brain. Unconsciousness in all its varying degrees is present at the time of the injury. With the restoration of effective intracranial circulation recovery is rapid and complete.

**TYPE (3)**—Injuries where a dilatation of the capillaries dominates the underlying pathology. Two subdivisions may be noted.

(a) Injuries where in addition to the reversible organic damage to the capillaries there is additional organic or anatomical damage of varying degrees amounting to contusions of the brain. Here unconsciousness is prolonged. Recovery is the rule but it is sufficiently slow for us

to observe that it occurs in a particular order or sequence. Lumbar puncture in such cases does not show any presence of blood in the cerebro-spinal fluid.

(b) Injuries where in addition to the reversible damage to the capillaries there are not only contusions but lacerations of the brain involving tears in the arachnoid mater. A lumbar tap reveals either a negligible number of red blood corpuscles or copious frank blood in the cerebro-spinal fluid. Recovery is the rule but it is apt to be slow and strong.

**TYPE (4)**—Injuries where in addition to reversible damage indicated under Types 2 or 3 there is an anatomical injury to blood vessels or blood channels (diploic, meningeal, cortical or deep seated) or to meninges. Injury to these structures produce at a certain stage certain symptoms of superimposed phenomena such as the massive haemorrhages, herniations, localised and generalised oedema of the brain. Unconsciousness is the rule. A complete or partial recovery is followed by a deterioration which tends to be progressive. Careful repeated observations indicate the type of complication which is superimposed. Suitable surgical measures alone can lead to recovery.

**TYPE (5)**—Injuries where anatomical damage is so severe as to preclude the possibility of recovery. Haemorrhages into the pons and the medulla are particularly common. Here the patient is unconscious right from the beginning and remains unconscious to the end.

Recovery from head injury may be complete or may leave behind certain residual symptoms. These sequelae will be mentioned at a later stage.

The clinical picture produced by these different types of injuries (Type 2, 3, 4 and 5) cannot be of a uniform nature. However clinical manifestations of brain injury in their onset and recovery follow a certain pattern. It is desirable to elaborate these points.

**ONSET**—All severe injuries to the head are attended with immediate unconsciousness. However, the degree of unconsciousness varies. It is important to fully appreciate the fact, that the prevailing degree of unconsciousness at any particular stage after the receipt of trauma is of the utmost diagnostic and prognostic significance. At one end of the scale is coma and at the other end is a mild degree of confusion of thoughts which may go completely unnoticed except by those who are aware of such possibilities.

During the stage of unconsciousness following immediately on a trauma to the head, the eyes are closed. If the eyes are not completely closed one may deduce that either the patient is progressing towards a recovery or sinking into coma.

**COMA**—Coma is a state of complete unconsciousness in which the eyes are half open and the corneal reflexes are either absent or sluggish. The other reflexes such as the swallowing reflex or tendon reflexes are often absent. The patient cannot be roused by either verbal command or by application of a painful stimulus such as pricking of the finger tips or pressure on the mandible. There is retention of urine with overflow.

(2) **Semicoma**—In this state there is some response to a painful stimulus. Forcibly pushing the jaw forwards and holding it there may be resented by the patient who moves his head to escape the torture. Swallowing and corneal reflexes are present. The bladder empties reflexly.

(3) **Confusion**—is a mere clouding of consciousness.

The Medical Research Council of England has graded confusion into severe, moderate and mild.

(a) In severe confusion the patient is inaccessible but can show adequate response to a simple command such as "put out your tongue."

(b) In moderate confusion the patient does not realise his surroundings but can give

relevant answers to simple questions such as "Where do you live?", "What is your name?"

(c) **Mild**:—The patient is capable of coherent conversation but is not yet completely oriented in regard to time, space and person. For instance he may keep on repeating the question he has already asked and which has been answered more than once.

However, there are still a few points to be noted as regards disturbance of consciousness which are not sufficiently appreciated.

Even in the full state of consciousness the degree of consciousness varies. Thus as a mere man you may observe and be conscious of a pretty face. A woman however in your place will also be conscious of the colour of the Sari, the pattern of the jewellery she has worn, the type of shoes she has put on and so forth.

However there may have been an actual loss of consciousness which may be missed. Thus a football player who gets kicked on the head during the concluding part of a game, may appear to rise from the ground and apparently resume the play. To a good observer the player seems to lack initiative. He may be noticed to misjudge situations. After his return to the pavillion he may ask of others what the score was or whether he played to the end of the game or not. Such a person may appear to his friends as not having been unconscious at all. There is no question that the higher functions of judgment and fine discrimination were absent. To that extent the player was unconscious.

Then there is a person who meets with an accident while driving a car. He extricates himself and drives home probably in a seemingly careless and dangerous way. Later he may not be at all aware of all that has happened. To all external appearances he was never unconscious. However, there is no question that his awareness to his surroundings was not complete.

Lastly there is a child who gets hit on the head by a cricket ball. The child may be dazed, but may pick himself up and resume the game. The child may be too young to express himself clearly. The people who saw the accident may definitely vouch that there was no unconsciousness and yet a few hours later a surgeon is

called to see the child in a deep state of coma, with evidence of hemiparesis; I have met with such a case in practice.

These points are of very great medico-legal importance. It is generally argued that in the absence of initial unconsciousness a given injury could not have caused sufficient damage to the brain to warrant the symptoms of headache, giddiness, etc. complained of by a patient claiming compensation.

**RECOVERY:**—In type 2 a man receiving an injury to the head falls on the ground in a state of complete unconsciousness. As described by Trotter this paralysis of the functions may extend momentarily to the forebrain, mid-brain and the hind-brain. The paralytic condition induced by anaemia, in the fore-brain, is responsible for unconsciousness, motor and sensory paralysis and paralysis of special centres. Mid-brain anaemia is responsible for paralysis of the oculo motor centre resulting in wide dilatation of pupils. The vital centres governing respiration, blood-pressure and cardio-inhibition are paralysed by anaemic condition of the hind-brain. This gives rise to short shallow respirations, low blood pressure and a fast running pulse. Depending upon the rapidity with which anaemia passes off, complete recovery occurs in a few seconds to a few minutes.

**Type 3:**—If unconsciousness in any sense is delayed beyond a few minutes, factors other than simple anaemia of the brain operate. The probable role of the capillaries in the mechanism involved has already been suggested. As unconsciousness is prolonged with a persistent low blood pressure and shallow respirations, a condition of increased  $\text{CO}_2$  tension of blood is produced, which stimulates the vomiting centre as also the other medullary centres already mentioned. The act of vomiting induces a contraction of the abdominal muscles which forces blood from the Splanchnic areas into general circulation increasing its efficiency and accelerating thereby the process of recovery. The recovery of the vaso motor centre helps to bring up the blood pressure to normal level.

It is important to note that recovery starts at the lowest and ends with the highest neurological levels. Symonds points out that a parallel exists in this respect in recovery from an epileptic fit. First the 'pulse, respirations and blood-pressure return to normal limits. This

indicates a phase of medullary control. The pupils that were widely dilated, become less so indicating a return of function at the mid-brain level. Soon the muscles which were flaccid regain their tone and the face that was placid and expressionless regains its expression indicating that the brain stem is recovering. Recovery of consciousness indicates that the higher neurological levels are returning to normal culminating in full recovery of the highest levels with return of powers of accurate judgment and fine discrimination. In the more severe types of injury of this category recovery of consciousness is a slow process necessitating repeated observations by one who is taught to appreciate the different degrees of consciousness, already described. The slightest sign of alteration in the depth of unconsciousness either one way or the other is a sure indication of recovery or regression. The patient may move a limb. The movement is of a purposive type such as a withdrawal of a limb from a painful stimulus. The patient may now pass from a stage of coma to a stage of semi-coma. He may improve to the stage of confusion associated however with restlessness. The patient may be resistive and even violent.

He may be foul of speech. Gradually behaviour becomes quieter but now a stage of automatism sets in. In this stage the patient will respond naturally to simple questions but is still unaware of his surroundings. He will repeatedly ask a question which has already been answered. He may probably carry on a conversation of which he has no memory afterwards. This stage of automatism, according to Symonds, is comparable to post epileptiform automatism. This stage is of great medico-legal importance. The danger is, that during this phase the patient may make statements which are untrue. Statements taken in such a state should be accepted with a certain amount of circumspection. Often there is a tendency to confabulate. False accusations may be made in connection with the accident.

Succeeding this phase of automatism, patient becomes more rational and recalls events. As he does so, it is found that there is a loss of memory for the injury, as also for events immediately preceding the injury. This loss of memory is known as retrograde amnesia. At first the patient may not be able to recall quite a long period extending over days preceding the accident. Gradually this period

of days shortens into a few hours or a few minutes preceding the accident. Careful notes must be made of the statements of the patient in respect of this retrograde amnesia from day to day. Existence of a retrograde amnesia is very definite proof of so-called concussion of the brain.

There is also a loss of memory for a period following the injury which includes the phase of automatism. This loss of memory is known as post-traumatic amnesia. Recovery is complete only when the patient is fully aware of his surroundings. Post-traumatic amnesia ends where full recovery of consciousness begins. It is a truism to say that the longer the period of post-traumatic amnesia, the greater the severity of the injury to the brain. Thus there is a regular sequence of events in the clinical manifestations of a head injury—traumatic stupor, traumatic automatism and traumatic amnesia. The recovery in all head cases is in this fashion. It may be very rapid or very gradual. It is the uniformity of stages and sequence which constitutes the essence of the clinical picture of every head injury.

There are a few other points which are worth noticing. After recovery of consciousness, as the patient remains confused, a certain amount of delirium is noticed in some cases at night. The state of confusion and restlessness is known as cerebral irritation. So long as there is delirium there may be a relapse into stupor from time to time. In the process of recovery there may be halts of varying duration. In our present state of knowledge such irritability is attributed to a varying condition of oedema. A patient who has become sufficiently conscious to answer a few questions may again lapse into stupor and may arouse the suspicion of compression of the brain by haemorrhage. However, in the case of uncomplicated brain injury the set-back does not go very far and there is a distinct tendency towards improvement. In the case of compression the stupor will become more profound.

The pupils, the superficial and deep reflexes show variations depending possibly on varying phases of congestion and anaemia in the different parts of the brain before the normal equilibrium is restored among the four constituents—blood C.S.F. tissue fluid and nerve matter.

During the phase of automatism the patient often complains of a headache. This is not

constant. Hence variable answers may be given to a nurse and a surgeon who may be happening to question the patient at different times.

During the stage of confusion variable plantar responses are obtained—sometimes an extensor and at other times a flexor. The temperature which is at first subnormal may rise a little for a couple of days. It is never higher than 102°. Pulse rate may follow the rise of temperature. In most of the cases there is often a secondary bradycardia which may persist for a week or ten days.

In the more severe varieties of Types 3 the early history is the same as in Type 2, except that the depth of unconsciousness is greater and the duration is often more than an hour. There is generally some shock attending this type of cases. The shock is to be treated in the ordinary way. Should no improvement set in within 2 or 3 hours the case needs careful and repeated watching. Should recovery not follow within 12 hours, one suspects either commencing oedema or subarachnoidal haemorrhage and the question of lumbar puncture is to be considered; a lumbar puncture earlier than 12 hours is not desirable. So many fluctuations occur in the relative balance between blood cerebro-spinal fluid and tissue fluid that any lumbar puncture will be harmful. Experience seems to indicate that stabilization occurs after about 12 hours. Hence it is important to know from this twelve hour period the level of the intracranial pressure as tested by a Spinal manometer. It is believed that the optimum conditions for recovery of damaged cerebral tissue are produced by maintenance of the normal balance between blood cerebro-spinal fluid, tissue fluid and brain matter. With available therapy we can reduce the pressure of the Cerebro-Spinal fluid by repeated lumbar punctures and we can control the volume of the tissue fluids by increasing the osmotic tension of blood by intravenous injection of Hypertonic solutions of glucose and sucrose. The increased osmotic tension of blood promotes the flow of tissue fluids from the perineuronal spaces into the venous channel. This helps to reduce the oedema of the brain.

Should the first lumbar tap show a pressure higher than 150 m.m. of water, sufficient fluid must be withdrawn to reduce the pressure to 50 m.m. which is the lowest limit of the normal.

If the Cerebro-Spinal fluid shows the presence of blood, it indicates a tear in the arachnoid membrane with subarachnoidal haemorrhage. If the cerebro-spinal fluid is heavily stained with blood a four hourly withdrawal is necessary until active bleeding stops as shown by cell counts. It is a practical method to collect the Cerebro-Spinal fluid in a test tube and let it stand. The amount of sediment in each successive collection will indicate whether the haemorrhage is regressing or otherwise. It is an exploded myth that a lumbar tap after 12 hours produces fresh bleeding. A certain amount of stiffness of the neck is noticed in cases where subarachnoid bleeding is heavy. After 18 hours a second lumbar tap should be done even if the case is improving. Should the second reading again show a high intra-cranial pressure repeated tappings must be reinforced by dehydration methods. Magnesium sulphate by mouth or by rectum or intravenous injections of glucose or sucrose are now well established procedures.

A third lumbar tap may be indicated after 24 hours. After that a 12 hours tap may be necessary to assure oneself that the intra-cranial pressure is being maintained within normal limits. The maintenance of a normal Cerebro-Spinal fluid pressure is the prime requisite for ensuring the normal relationships among the four constituents of the cranial cavity.

In all cases that do not regain consciousness within a couple of hours the importance of repeated observations has been stressed. Nurses should be trained in this respect. During this period of observation an hourly or two hourly note has to be kept about the level of consciousness, the pulse, temperature, respirations, blood-pressure, the pupils, the appearance of convulsions or any motor paralysis and any alteration of the various reflexes.

These observations will lead one to make certain Surgical decisions.

A case may seem to improve under repeated lumbar punctures and the dehydration measures after the first twelve hours. Then for no reason whatsoever the depth of unconsciousness increases. Reliable localising signs are absent. A right sided exploration (in a right handed person) is indicated. The procedure is the same as for a decompression. Probably the underlying pathology is genera-

lised oedema of the brain. Half hearted measures in the shape of a mere decompression are not satisfactory. Perceival Bailey has pointed out that the brain may increase fifty per cent. in volume. On incising the dura the Cerebro-Spinal fluid may spurt to a height of a few inches indicating an external hydrocephalus. The brain underneath may appear pinkish in colour, tense and non-pulsating. Under such circumstances it is best to follow Dott's advice and put in an exploring cannula into the ventricle. If the ventricle is collapsed it indicates an expanding lesion on that side. If the ventricle is dilated it indicates an expanding lesion on the opposite side or in the posterior cranial fossa.

After 12 hours a dilated pupil on one side even in absence of decerebrate rigidity is an indication for a decompression on the side of the dilated pupil.

If after 36 hours the Cerebro-Spinal pressure remains very high without recovery of consciousness a right sided decompression (in a right handed person as ascertained by enquiries to friends or relations) is indicated. It may be stated as an axiom that so long as the cerebro-spinal pressure is high with a good cardiac condition there is hope for the patient.

When diagnosis seems doubtful and unconsciousness is not relieved after suitable measures, increasing use must be made of bilateral inspection holes. An unsuspected subdural haemorrhage or subdural collection of yellowish fluid may reward one's efforts. The holes are most conveniently placed about 1½ to 2 inches above the external auditory meatus.

It is during this period of observation that certain clinical evidence will be forthcoming to indicate a fatal termination.

If the temperature in the early stages rises above 102° and subsequently continues to rise a fatal termination is to be predicted. Extensive lacerations are always accompanied by a high initial temperature.

A secondary rise of temperature in an observed case is the harbinger of death.

A patient may remain unconscious for days but if his pulse and blood pressure remain within normal limits there is hope that the patient may recover. However should the pulse

rate rise and the pressure fall a rapid end is indicated. Normal respirations are always of good prognostication. Stertor is a sign of an early end. A sustained high intracranial pressure in the presence of stupor is an indication for persevering with efforts to save patient's life. It indicates in the absence of subarachnoidal haemorrhage, either a generalised oedema or external hydrocephalus. A low or subnormal intracranial pressure in a comatose patient indicates that the medullary centres are failing.

The presence of red blood corpuscles in the cerebro-spinal fluid indicates subarachnoidal bleeding. The larger the number of red blood corpuscles in the fluid the severer is the injury. However, it is not possible to prognosticate purely from this angle. Russel has observed that red blood corpuscles tend to disappear rapidly from the first day after the accident and that at the end of four or five days the cerebro-spinal fluid becomes clear or yellowish brown in colour. Fresh appearance of red blood corpuscles indicates a renewal of haemorrhage.

Signs of tentorial cone formation appearing within twelve hours indicates extensive generalised oedema with extensive lacerations which are always fatal.

Contusions of the orbital surfaces of the frontal lobes give rise to rapid respirations, elevated temperature and bronchial hypersecretion leading to a mistaken diagnosis of pneumonia.

**TYPE 4:**—In this group there is initial unconsciousness after which there is either a rapid or gradual recovery. The patient seems to remain well for varying periods of minutes, hours or days. This is known as the lucid interval. After a varying length of lucid period certain clinical manifestations appear which indicate the supervention of:—

- (1) Extra dural haemorrhage.
- (2) Subdural haemorrhage or haematoma.
- (3) Subdural hydroma.
- (4) Herniations of the brain
- (5) Hydrocephalus.

An injury of this type may come under the notice of the surgeon when the patient is first knocked unconscious, or when he is conscious

during the lucid interval or when he lapses a second time into unconsciousness.

**Extra dural haemorrhage:**—If the patient happens to be under observation right from the beginning, the first symptom during the lucid interval, to arouse suspicion of an impending complication such as extra dural haemorrhage, is increasing headache. Giddiness and mental confusion follow, leading up to stupor. The stupor may be mistaken for natural sleep should it happen to set in when the patient is naturally expected to sleep. In right handed persons a left sided lesion may proclaim itself by aphasic difficulty.

Extra dural haemorrhage may arise from one of the four following sources:—

- (1) Middle meningeal vessels
- (2) Diploic vessels
- (3) Longitudinal sinus.
- (4) Petrosal, Sphenoidal or cavernous sinus at the base.

Injuries occurring at work or play in the shape of direct trauma over the temporal region are more likely to produce extra dural haemorrhage than an automobile accident. Extra dural haemorrhages are uncommon in childhood and in old age. At these periods of life the dura is firmly adherent to the bone and is likely to tear along with a fissured fracture. The tear in the dura mater acts as a safety valve.

In certain cases of extra dural haemorrhage the injury appears to be of a trivial nature. The extra dural collection takes place usually over the temporal lobes, sometimes over the occipital lobe and rarely over the cerebellum. If the collection occurs over the temporal and parietal lobes convulsive twitchings of limbs occur followed by paralysis. In a fully developed case the pulse is below sixty and the blood pressure is high. A fixed dilated pupil on the side of the haemorrhage may or may not be present. It is usually a late sign. When pyramidal signs, as shown by paresis, are confined to one side of the body, the side on which haemorrhage has occurred is easily determined. If haemorrhage is allowed to progress bilateral motor signs rapidly appear and diagnosis becomes difficult. On the side involved first, spasticity gives rise to flaccidity. Spasticity is due to venous congestion produced by the increasing pressure of the extra dural collection. When haemorrhage continues, the

increasing pressure induces an ischaemia of the cortex which gives rise to flaccidity. But the side on which paralysis appears later is still spastic, when flaccidity appears on the original side. Naturally the side of the brain to operate will be the one opposite that of the flaccid paralysis.

An X-Ray film of the skull showing a crack running through the track of the meningeal vessel will determine the side on which one should operate. A lumbar tap will reveal an increased intra cranial pressure. No red blood corpuscles are present in the cerebro-spinal fluid unless there is an associated tear of the arachnoid mater.

### **SUBDURAL HAEMORRHAGE:**

Subdural haemorrhage is either generalised and acute or localised and chronic. When localised and chronic it is often spoken of as subdural haematoma.

Acute generalised haemorrhage is generally associated with severe cranio cerebral trauma with tearing of the arachnoid. As the arachnoid is torn some cerebro spinal fluid escapes into the subdural space mingling with the blood and probably preventing its clotting. The acute bleeding comes from the cortical veins. Hence the clinical picture is that of severe types of cerebral injury in which the subdural collection of blood plays but a small part so far as signs and symptoms are concerned. However, in some few cases the collection under the dura may be extensive enough to cause compression symptoms. The latent period may be a few minutes or hours depending upon the rapidity with which blood collects. Sometimes in the earlier stages of initial recovery there is marked irritability to which Trotter has drawn attention. In this stage the patient is violent and is a veritable fighting automaton. Should his breath smell of alcohol a wrong diagnosis of alcoholic intoxication is arrived at and the patient is wrongly taken to a police lock-up. This stage is followed by insidious paralysis and stupor. Again this is looked upon as the soporific effect of alcohol and the patient is found dead the next day in the police cell.

No operative procedure is necessary unless there is an associated depressed fracture or unless there is evidence of compression with manifestation of motor paresis. In fact some acute subdural haemorrhages are discovered while exploring for an epidural haemorrhage.

After opening the dura the blood is best sucked up. If the bleeding point is seen it may be dealt with. It is not wise to search for bleeding points. A cigarette drain is necessary.

### **Local or Chronic Subdural haematoma:**

The relationship of trauma and particularly insignificant trauma, to subdural haematoma was pointed out by Wilfred Trotter in 1914. The patient may be more than just dazed at the time of the injury. The trauma is generally a fall on the frontal or occipital regions. The axis of the trauma is in the anteroposterior direction. It is the gliding action of the brain in an antero-posterior direction which is most likely to rupture the tethering veins which connect the cortical veins with the longitudinal sinus. The most common age is between 40 and 70 years. The most common location of the haematoma is the lateral aspect of the fronto parietal regions rarely over the occipital lobe or the cerebellum. Dandy and Peet have each recorded a subdural haematoma involving the pituitary region.

Munro has made an extensive study of these haematomas and has divided them into solid, mixed (solid and fluid) and purely fluid. Munro states that the age of a haematoma can be judged either from a microscopic study of the dura and the limiting membrane of the clot or the protein content of the fluid. This age can be determined up to two to four months. The average latent period between the injury and the first appearance of the symptoms is three weeks. However, the onset of symptoms may be delayed by several months. The symptoms are those of an expanding lesion and are therefore progressive. A persistent though intermittent headache after the initial recovery, should always keep one on one's guard. Poor memory, mental confusion, the making of repeated mistakes in ordinary routine work, irritability of temper and change of personality should be regarded as some of the non-localising manifestations of this trouble. Convulsions, paresis or paralysis depending upon direct compression or due to massive displacement of brain causing the opposite cerebral peduncle to be compressed by the unyielding incisura tentori so that pyramidal signs and paralysis may be found on the same side as the haematoma. Variability of signs and symptoms from day to day or even from hour to hour may be a noteworthy feature. Encephalogram may be of value.

However, the best plan is to explore by making burr holes in the temporal region on both the sides if necessary. The dura will look bluish and bulging and on incision will yield a dark red coloured or a light coloured fluid.

**SUB-DURAL HYDROMA:**—A subdural hydroma is a collection of a clear colourless or yellowish fluid under the dura. It is unassociated with a subdural haematoma. Probably at the time of the injury the arachnoid is torn in a valvular manner allowing the Cerebro-Spinal fluid to escape into the subdural space but preventing its return. Such an escape into the subdural space would be promoted by any act which leads to increased intra-cranial tension such as coughing, vomiting or sneezing. The symptoms produced would be similar to those of a subdural haematoma. Diagnosis will be confirmed by an exploratory trephine opening, usually over the parietal area. A careful incision over the bulging dura will cause a gush of clear fluid. The dura is cut in a stellate fashion over the site of the hydroma. Nothing further need be done.

#### HYDROCEPHALUS:

An internal or non-communicating hydrocephalus is rare. An external or communicating hydrocephalus implies that the Cerebro-Spinal fluid can escape from the foramina of Majendie and Luschka on to the surface of the brain, but cannot be absorbed at the natural rate by the Pacchionian bodies which are blocked by disintegrating red blood corpuscles.

An obstruction to the free flow of the Cerebro-Spinal fluid can also occur as the result of an accumulation of a clot under the arachnoid mater on one side. One often sees such a localised external hydrocephalus while cutting into arachnoid mater and finding a stream of yellowish or lightly blood stained fluid spurting out under great pressure. The condition necessitating such an exploration would be a delayed hemiplegia.

**HERNIATION OF THE BRAIN:**—The evil effects of straining on the brain volume are well-known to surgeons who some times see a brain visibly enlarging during a cranial operation. Thus during craniotomy struggling on the part of the patient as the result of unsatisfactory anaesthesia, leads to a prompt bulging of the exposed brain through the bone opening engorgement of its vessels and even spontane-

ous rupture of some large cortical vein. If the cranial cavity is intact it is easy enough to realise that as the result of increased brain volume or increased tension in a supra tentorial compartment a part of the brain may be squeezed out of one compartment into another. Such a process is known as herniation. The brain may swell as much as fifty per cent. of its volume as the result of trauma. Oedema which accompanies every severe brain injury, may be either localised, when it produces focal symptoms, or may be generalised when it causes different kinds of herniations.

Apart from oedema, intra cerebral or subdural haemorrhage may also cause herniation by raising the intra-cranial pressure in one dural compartment sufficiently to force the contents out.

Herniations occurring within twelve hours of the receipt of a trauma are always fatal and are due to a very rapidly spreading oedema of the brain. Herniations which take longer to develop are amenable to surgical procedures, as they are usually the result of accumulation of blood in a supratentorial compartment. Three distinct types of herniations may be described.

(a) The tentorial pressure cone. Jefferson coined this name and described its mechanism. A rise in the supra-tentorial part of the cerebrum will force the inner surface of the temporal lobe (uncus) through the opening of the tentorium and produce a herniation. The herniated portion displaces and compresses the mid brain. The efferent and afferent impulses from and to the cortex are cut off and the neural mechanism below the ring of compression is released from the control of the higher centres. The Red Nucleus is situated at this level and has an inhibiting influence on the contraction of muscles maintaining an upright posture. If the nucleus is put out of action, the muscles responsible for maintaining erect posture are released from its inhibiting influence. Such a release phenomenon gives rise to the condition of decerebrate rigidity. All the muscles of the body and limbs become rigid in the extended position. Thus the hips and the knees are fully extended and the ankles plantar flexed. Any attempt to move the joints passively is defeated by the sustained spasm. With the establishment of decerebrate rigidity the Red nucleus ceases to function but Deiter's nucleus situated at a lower level still



continues to function. When Deltor's nucleus is also thrown out of gear, the extensor muscles become relaxed and the flexors go into a spasm so that the body and limbs show evidence of acute flexion. Further, at the tentorial level is situated the third cranial nerve, which may be stretched or compressed by the process of herniation. Such an injury to the nerve produces a dilated and later a fixed and dilated pupil which is of considerable value both as a diagnostic and a localising sign. If unrelieved, the tentorial compression leads to deepening coma and death. If treated efficiently it constitutes the dramatic in surgery by the prompt restoration of consciousness. In some cases tentorial herniation may be bilateral. To a less extent the cerebral peduncle of the opposite side is pressed against the sharp margin of the tentorial aperture and symptoms of paresis will manifest themselves also on the opposite side.

#### THE CEREBELLAR PRESSURE CONE OF CUSHING.

If the rise of pressure in a supra tentorial compartment is very slow as in the case of a subdural haematoma or an intra cranial tumour, the dural partitions of the tentorium yield quite considerably and the increased pressure is distributed more equitably with the result that the infra tentorial compartment receives its share as well. Local herniation under the tentorial aperture does not occur. However, the bony ring at the foramen magnum will not yield to the increased pressure in the infra tentorial compartment and the evil effects of the increased pressure will be felt at this level. Thus the rising pressure in the infra tentorial fossa may force the tonsils of the cerebellum through the foramen magnum into the spinal column, producing a compression of the medulla. The striking features of such a herniation are rigidity of the necks, spasticity of the extremities and a marked increase in intra cranial tension resulting in a secondary hydrocephalus produced by a virtual closure of the apertures of the fourth ventricle. A choked disc may be noticeable. Respiratory embarrassment is particularly common. Spinal puncture in such a case is truly dangerous.

#### BASAL SHIFT OR HERNIATION UNDER THE FALX.

This occurs in cases of rapidly increasing intra-cranial pressure in a supra-tentorial compartment, when a part of the brain in that

situation is forcibly dislocated under the arch of the falx. The main clinical feature is impairment of consciousness.

X-Ray investigations play a minor role in the diagnosis of closed head injuries. Hence skiagraphic studies should not be undertaken until the patient is well out of shock. From the practical point of view the importance of a skigram lies in the positive evidence it affords in suspected cases of epidural haemorrhage. A fracture line passing across the course of the middle meningeal artery or its branches would give a definite indication for surgical interference. A skigram has a distinct medico-legal importance. A skigram depicting a fracture is looked upon as the most convincing argument in a court of law to prove that a serious injury to the skull and its contents has occurred in a given case. A fracture line may be noticeable for three or four months in a child and probably for a year in an adult after the date of the accident. A linear fracture of the base is often missed because of overlying shadows. Clinical evidence of a fracture of the base is more important than the radiological evidence. In interpreting a skigram linear fractures may be confused with meningeal grooves, diploic channels and suture lines. However, a fracture line can run in any direction. It has clean cut edges. Any change in the direction of the fracture line is abrupt. It may cross arterial or suture markings. The fracture line is wider at its origin than its termination. In a comminuted fracture there is a central splintered island or bone from which linear fracture lines radiate. This type of fracture indicates severe cerebral damage. Depressed fragments are best detected by a stereoscopic radiography. An inward displacement of 0.5 c.m. or more is sufficient to press upon the brain. Such a depression, when detected, constitutes an argument for either an elevation or a removal of the fractured fragment. The presence of an air bubble in the cranial cavity is easily demonstrated in a skigram and is of some prognostic significance. The locked up air is a potential source of infection. Browder in a personal communication to Brock states that in 10 out of 15,000 cases of head injury the presence of air was demonstrated in the ventricles.

Ventriculography and encephalography are beginning to be recognised as of some value in

acute traumatic lesions when unconsciousness either persists or regresses after 24 or 36 hours. Ventriculography is safer than encephalography because less air is used. Further the air can be reaspirated at the end of the investigation. There is a less likelihood of a cerebellar or tentorial cone being precipitated. The procedure also enables one to maintain intracranial pressure within normal limits.

Ventriculography, encephalography and electro-encephalography have a great value in revealing very important information in respect of some of the sequelae of head injuries such as epileptic seizures.

## THE TREATMENT OF CLOSED INJURIES.

Head injuries can stand transport better than abdominal casualties. Transport by aeroplanes above an altitude of 4,000 feet is not advisable. To maintain a free air way and prevent a falling back of the tongue, a lateral posture is to be adopted during transport. This position also allows the saliva to trickle outwards. A quiet darkened room in a well equipped hospital is highly desirable.

The treatment of co-existing shock has already been emphasised. Training the nursing staff to recognise the different levels of unconsciousness is very important. Unconsciousness is the most important sign indicating the extent of generalised damage to the brain. An increase or a diminution of the depth of unconsciousness is the most practical demonstration of recovery or deterioration.

**Position of the head:**—The head may be kept low if there is any associated condition of shock. After the condition of shock has passed off, the head may be kept elevated to prevent venous congestion. Once the cerebro-spinal fluid pressure is found to remain normal, the head should be kept level with the body or even lower. Should headache return, the head of the patient must be kept low again. In truly traumatic headaches the head low position gives prompt relief. A malingerer will of course not be relieved by such a procedure. He will find the position and the enforced rest too irksome for him to continue to plead a post-traumatic, headache!

**Restlessness:**—Reassuring a patient that everything is being done for his good goes a long way to soothe him. Protection of the patient against accidental falls from a bed may

be ensured by converting an ordinary bed into a cradle by providing side-supports. Forcible restraint increases struggling with attendant rise of intra-cranial pressure. A straight-jacket has no place in the treatment of head injuries. Soluble luminal grs. III given intravenously followed by chloral hydrate grs. X and sodium bromide grs. XV are adequate measures for controlling restlessness. Paraldehyde four drachms in six ounces of oil per rectum is also useful. Morphia is best avoided. Ice caps are of doubtful value. Munro suggests that the only conceivable use of an ice-bag is in an uncooperative patient. Such a patient may be rendered somewhat quieter because of a possible subconscious desire to successfully balance it and thus obviate the imagined disorder that might result from its dislodgement.

**Feeding:**—If oral feeding be not possible a small-sized duodenal tube may be passed through the nose to reach the stomach. Temple Fay of Temple University, Philadelphia, is a great advocate for restricting the fluid intake for the first two or three days. The daily output of Cerebro-Spinal fluid can be reduced by restricting the fluid intake. Diminishing the amount of Cerebro-Spinal fluid will certainly help to keep down the intra-cranial pressure. It is therefore desirable to withhold fluids but not to such an extent as to produce the toxic effects of dehydration. These toxic effects are very liable to be produced particularly in children. The toxic effects of dehydration may be noticed either in the first 2 or 3 days or later between the tenth and the fourteenth days. It will be precipitated and accentuated by vomiting or excessive sweating. The suspicious signs are a dry mouth, a furred tongue, a non-elastic skin, a sunken condition of the eyes, a rising temperature, delirium, increasing stupor and a subnormal Cerebro-Spinal fluid pressure. The quantity of urine is diminished. Its specific gravity is high. There is a trace of albumin in the urine. Casts may be present. Prompt relief offered by a free administration of fluid proves the diagnosis.

One ounce of water every one hour is the minimum requirement for the first 24 hours.

When unconsciousness is deep and C.S.F. pressure high, two pints of fluid a day are essential. When consciousness returns three pints may be given. Alternately with glucose water, milk may be given at this stage. Nutri-

tional needs will be satisfied by about forty ounces of milk. It should be given in divided doses not exceeding five ounces at a time.

The minimum total fluid needs of an adult in this country would be 3,500 c.c. If necessity demands that the total quantity be given by either the intravenous or parenteral route, and should glucose and normal saline be employed, there is a distinct possibility of an overdose of sodium chloride. The total sodium chloride intake should average between five and six grammes a day. Hence a limited quantity of normal saline should be used and the further fluid needs be supplied by the use of 5% glucose solution (without sodium chloride). Later, fruit juices, milk jellies, custard, etc., may be added to the daily dietry.

**The Bowels:**—Diarrhoea associated with restlessness is distressing. Correct it with Bismuth and opium. Constipation should be avoided as any straining at stool is likely to raise the intra-cranial pressure. A two ounce glycerine enema is more convenient than a large cleansing enema.

**The Bladder:**—Years of habit of a civilized life cause a man to seek evacuation of the bladder at certain intervals and in certain convenient positions. The forced recumbent posture is a real obstacle to many. There is aprexia. The patient does not empty the bladder because he does not know what to do. The distended bladder makes him restless and he may attempt to get out of bed to empty the bladder. Timely catheterization will ensure considerable comfort to the patient. When there is an incontinence a bidette may be fitted to a female patient and a large sized rubber tubing may be fixed over the penis in the male and secured in position by means of an adhesive tape.

**The Skin:**—Bedsore must be prevented by good nursing. A very restless patient may produce serious abrasions over knees, elbows and the heels as the result of constant movement and friction. These parts require to be protected by the tying of a bandage over a liberal pad of cotton wool.

Neglect of oral hygiene will lead to parotitis.

**Temperature:** A rise of temperature may be treated by tepid sponging. Rowbotham recommends intravenous injection of 20 grs. of aspirin if temperature cannot be controlled by

other means. To give aspirin intravenously it should be dissolved in alcohol. The Alcoholic solution is to be injected very slowly.

The operative line of treatment in cases of closed injuries of the head will be required in a small percentage of cases. (1) Thus a craniotomy of an exploratory nature may be indicated. The importance of early small exploratory holes is already mentioned. Sometimes such an exploratory operation may be much more extensive.

(2) An operation may be indicated for associated injuries such as wounds of the scalp or a depressed fracture.

(3) Some of the superimposed phenomena such as epidural haemorrhage, and tentorial herniation will demand a well thought out plan of action.

(4) Operative procedures will be required for some of the more late complications or sequelae of head injuries such as a sub-dural haematoma, cerebro spinal rhinorrhoea, post traumatic epilepsy, persistent vertigo of a labyrinthine origin, arterio venous aneurysm.

(5) Very rarely a purely palliative decompression operation will have to be done, either unilateral or bilateral, to relieve generalised oedema. In the past it was frequently employed to relieve intra-cranial pressure where symptoms and signs were not of a localising nature. A simple subtemporal decompression merely increases the cranial capacity temporarily. Within a short time a new equilibrium is established and the decompression becomes useless.

In fact the brain may bulge through the exploratory opening seriously impairing the function of the part of the brain involved in this process of herniation. In all such cases, where a palliative decompression is required, it should be done over a silent area. A left-sided sub-temporal decompression may end up in aphasia in a right handed person. It is best to ascertain from the nearest friends or relations whether a person is right or left handed before resorting to decompression. Another practical detail to be observed is that the relieving incision in the dura should not extend higher than the Sylvian fissure. Otherwise the lower end of the motor area will be endangered.

The details of equipment and technique of cranial and intra-cranial operations are so well known, as not to need any elaboration before the present audience.

It remains now to enumerate the complications resulting from the treatment employed.

- (1) Adherent operation scar.
- (2) Large sized cranial defects.
- (3) Retained foreign bodies introduced at the time of the operation such as silk sutures, cotton patties, unabsorbed muscle grafts, dead bone.
- (4) Broken lumbar puncture needle.
- (5) Post operative Cerebro-Spinal fistula.
- (6) Fungus cerebri.
- (7) Infections.

**The Convalescence:**—A proper management will reduce to a great extent the residual symptoms of head injury such as head-ache, dizziness, etc. For practical purposes it is best to divide convalescence into three periods.

**The First Period:**—This begins when lumbar punctures show that the intra-cranial pressure has returned to the normal level and has no tendency to rise again. During this period it is important to keep the patient in bed flat on his back. The importance of the position of the head has already been pointed out. The modern tendency is to shorten this period. In fact it should never be prolonged beyond a fortnight.

**The Second Period:**—Part of this period is spent in the hospital and part at home of the patient. Get the patient first to sit up in bed for increasing periods. After two or three days get him out of his bed and encourage him to do so whenever he wants. This demonstrates to him and to his relations that he can now be active at home and yet have no symptoms. He should not be encouraged to have breakfast in bed. He can now go home being fully assured that he will have no mental trouble in spite of his being informed to the contrary by well meaning but disgustingly stupid visitors and friends. He is advised to spend about nine or ten hours in bed whether he sleeps all that time or not. He is encouraged to read, or occupy his time in a suitable hobby. Moderate exercise is recommended. The importance of the regulations of bowels is stressed. If post

neurotic symptoms are to be minimised, the patient should see as little of his doctor as possible. He must begin to depend upon himself to find out whether he is over exerting himself and then correct himself accordingly. If possible insurance agents, lawyers and fussy friends should be excluded from contact with the patient during the period.

This period need not be extended beyond a month. In fact the patient should be encouraged to cut down the extra period of rest in bed and prepare himself for his daily occupation. The real trouble arises when the patient is non-cooperative and various problems of a medico legal interest arise in respect of compensation. This part of the subject is so vast that it cannot be discussed at this juncture.

As a final parting advice the patient is told not to indulge in alcohol for the rest of his life, not to go out in the open sun, not to dive head first into water and not to go on to high places without adequate protection.

### SUGGESTED SCHEME FOR INVESTIGATING CASES OF HEAD INJURY.

Name, etc.

(Retain every case of head injury unless definitely trivial. Take a signed statement from the patient should he wish to go away against medical advice.)

Degree of shock present:—Mild, Moderate, Severe.

		S		
Colour	B.P.	—	Pulse	Temp.
		D		

Respirations:—Frequency Character.

Odour of breath:—Diabetic, Uraemic, Alcoholic. (Treat Shock if present).

(If shock is not present or as it is being treated, note down the history of the accident as given by the patient or by others.)

Name and address of the person giving the history of the accident.

Type of Accident:—Automobile, Tram, Train

Time of Accident:—Day Hour.

Place of accident.

(If no shock is present, or after shock has been treated look for evidence of injuries.)

## (A) Evidence of extra cranial injuries.

- (1) Limbs:—Fracture, open wounds.
- (2) Abdomen:—Rigidity, Liver dullness, Shifting dullness, Superficial reflexes.
- (3) Chest:—fracture ribs, Surgical emphysema, hamothorax pneumothorax.
- (4) Spine:—Irregularity over the Spine  
Flaccid paraplegia. Brachial plexus injury.

(Shave head if necessary).

## (B) Evidence of injury to scalp and face

- (1) Lacerations.
  - (a) Scalp
- (2) Tumefactions
  - (b) Face
  - (c) Conjunctiva
  - (d) Temporal muscle
- (3) Depressions.
  - (a) Orbital
- (4) Discolouration
  - (b) Conjunctival
  - (c) Retro-mastoidal

## (C) Evidence of Cranial injury.

- Fracture
- (1) Depressed.
  - (2) Fissured.

## (D) Evidence of simultaneous Cranial and intra-cranial injury:—

- (1) Blood through orifices or under galea.
- Escape of (2) C.S.F. through orifices or under galea.
- (3) Air, Surgical emphysema, aerocele.
- (4) Brain substance, through orifices or open wounds.

## (E) Evidence of Intra-cranial injury (non-localising).

## (1) Degree of Unconsciousness:

- (a) Comatose—No response to painful stimuli, e.g., pressure on testes, pricking finger tips, pushing the jaw forward etc.

Jaw—dropped. Eyes half open.

Corneal reflex—Swallowing reflex—

Tendon reflexes—Retention of urine;

## (b) Semicomatose

Responds to painful stimuli.  
Eyes closed.  
Swallowing reflex—Corneal reflex  
+ Deep reflexes + Bladder empties reflexly.

## (c) Confusion

(Test for orientation from point of time, place and person).

- (i) Severe—patient is inaccessible. Just responds to simple commands e.g. "Put out your tongue."

- (ii) Moderate—does not realise surroundings, responds to simple questions, e.g.  
"Where do you live?"  
"What is your name?"

- (iii) Mild:—Coherent conversation possible.

Not completely oriented yet, e.g. keeps repeating a question already answered.

## (2) Restlessness.

## (3) Delirium.

## (F) Evidence of intra-cranial injury (localising)

## (1) Forebrain damage:—

- (a) Convulsion, movement,
- (b) paresis or paralysis,
- (c) Special centres e.g. speech.

## (2) Cranial Nerves

## (3) Posture (Red Nucleus, Deiter's Nucleus)

## (4) Rigidity or flaccidity in paralysed limb (condition of cortex).

## (5) Evidence of Mid-brain damage.

(a) Pupils	Left	Right
Size	...	...
Reaction	...	...

- (b) Abnormal position of eyes
- (c) Incoordination of eye movements
- (d) Restriction of movements of the eye
- (e) Skew deviation
- (f) Squint
- (g) Nystagmus.

## (6) Evidence of hind-brain damage

- (a) Pulse. (b) B.P. (c) Temperature.
- (d) Respiration (frequency, type).
- (e) Vomit.

(Repeat all these observations every half hour or less frequently with special reference to level of unconsciousness).

(Repeat observations until patient is fully conscious.)

(Full consciousness begins where post traumatic amnesia ends.)

Note Duration of Post traumatic Amnesia.

(As patient regains consciousness and begins to narrate the events leading up to the accident, keep careful notes of the statements from time to time to enable a final check up on the length of retrograde amnesia).

Make note of retrograde Amnesia, its presence and its duration.

(A very smooth narration is generally a result of coaching from interested quarters).

(If patient does not regain consciousness after 12 hours do a first lumbar puncture).

#### 1st LUMBAR PUNCTURE.

- (1) Pressure of C.S.F. as measured by a manometer.
- (2) Naked eye characteristics.
- (3) Evidence of R.B.C. (microscopic) number of cells per one cubic m.m.
- (4) Quantity of fluid removed to bring C.S.F. pressure to lowest normal level. (If first tap is heavily stained with blood do a second lumbar puncture after 16 hours. Repeat lumbar punctures every 4 hours until C.S.F. is clear, repeating same observations.

If first lumbar tap is free from blood do a second lumbar tap after 18 hours, even if case has recovered.

#### 2nd LUMBAR PUNCTURE.

(If second lumbar tap shows a high intra-cranial pressure start dehydration therapy—50% glucose or sucrose.

After 24 hours do a 3rd Lumbar tap and note manometric pressure. If C.S.F. pressure is high, repeat a lumbar tap every 12 hours until C.S.F. pressure remains normal.)

#### NATURE OF SURGICAL MEASURES EMPLOYED.

Daily notes should emphasise (a) Level of consciousness, (b) post traumatic Amnesia, (c) retrograde amnesia, (d) headache, (e) pulse,

(f) temperature, (g) respirations, (h) blood pressure, (i) C.S.F. readings, (j) Pupils, (k) reflexes, (l) sleep, (m) delirium, (n) restlessness, (o) vomiting.

#### Accessory examinations

- (1) X-Ray—Plain, encephalography, ventriculography.
- (2) Ophthalmoscopy.
- (3) Auroscopy.
- (4) Electro-encephalography.

#### EVIDENCE OF ASSOCIATED DISEASES

Particularly Syphilis and Arterio-sclerosis.

Diagnosis (a) Pre-operative, (b) post-operative, (c) Full diagnosis, e.g. (a) Head injury Type 3(b); (b) haematoma left parietal region, (c) fracture left parietal region, (d) probable contusion left parietal lobe, (e) traumatic subarachnoidal haemorrhage.

#### POST MORTEM NOTES

FOLLOW UP: Headache, giddiness, nervous symptoms, epileptic seizures medico-legal complications.

#### DISCUSSION

R. Mahadevan, Vizagapatam, wanted elucidation on the following points:—

(I) When a patient is brought unconscious with a recent head injury, one sometimes hesitates to adopt dehydration therapy, for fear of restarting a haemorrhage that may have just stopped. Are there any guides to decide when it is safe to institute methods of dehydration?

(II) In a patient stuporose or unconscious with head injury, the pupillary changes sometimes occur in bizarre fashion. At one moment one of the pupils is moderately dilated while the other is normal, but after a very short interval, the pupils show a reverse condition without any obvious change in the clinical state of the patient. Such changes have occasionally been demonstrated to the students. What is the significance of such pupillary changes? I may add that the few patients that showed such pupillary changes eventually did well. In no such case was any operative interference required.

He made the following statements as being worthy of particular mention:—

- (1) All depressed fractures of skull in the adult are compound.
- (2) Sulphathiazole is not to be used for cerebral wounds. "It is the only one of the sulpha group which is dangerous if applied to the brain surface, since it causes fatal fits when it is put in too high a concentration in contact with the cerebrospinal fluid i.e. it cannot be freely sprinkled on the brain surface"—(Geoffrey Jafferson, 1945).
- (3) Some at least of the deaths in patients unconscious with head injuries, are possibly due to insufficient feeding. At any rate insufficient feeding tips the scale against the chance of recovery in some cases. The feeding of unconscious patients must be in the hands of well trained nurses. Intragastric drip feed has a place in feeding these patients; the feeds consisting of milk, egg-flip, fruit-juice, glucose water, normal saline, plain water, etc.
- (4) The need for a thorough general examination of all patients with head injuries and particularly so when they are brought in unconscious, cannot be sufficiently stressed. A slackness in general examination may result in other serious injuries being overlooked—injuries serious enough to be the ultimate cause of death. I know of a case where an unconscious patient had not only a head injury but also a severe fracture of the jaw. This fracture was missed and death resulted from asphyxia caused by the tongue falling back.
- (5) In dealing with compound depressed fractures of the skull, if the dura is intact, it is usually wise not to open it for further examination of the state of structures underneath. However, there are conditions, where, even if the dura is intact, it may have to be opened. They are:—
  - (i) if there is no pulsation of the brain;
  - (ii) if there is dark discolouration underneath suggesting haemorrhage.

The following brief case reports testify to the well-known aphorism that "No head injury is

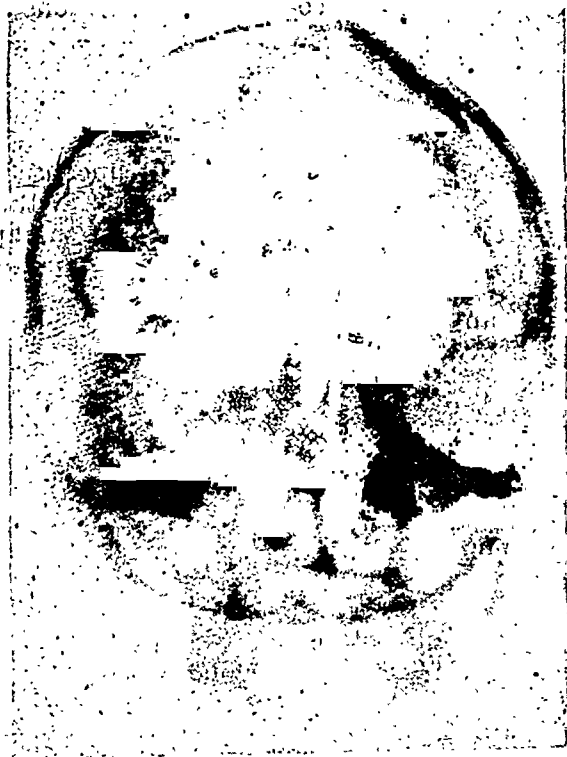


Fig. I

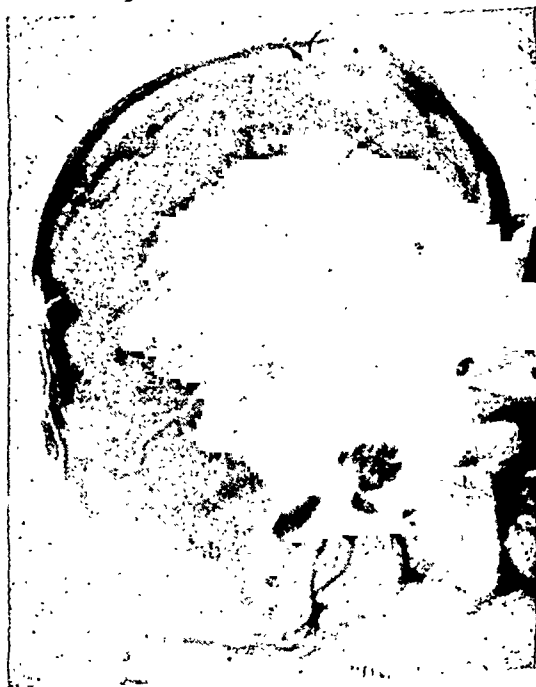


Fig. II

Figures I and II show a severe, compound depressed Fracture of the skull. Patient was brought unconscious and had right sided hemiplegia. Scalp wound was excised and depressed fragments removed. He was unconscious for eleven days, but ultimately completely recovered.

serious as to be despaired of, or so trivial as to be neglected":—

- (1) A man of 35 had a direct hit on the head with a stick resulting in a severe compound fracture of the skull (Figs. 1 and 2). He was brought to hospital 24 hours later deeply unconscious. There was hemiplegia of the right side. The depressed fragments were removed after debridement of the wound. He was unconscious for 9 more days and on the 11th day of the injury began to slowly regain consciousness. The hemiplegia also gradually disappeared and he was discharged about 7 weeks after admission having reached a practically normal state.
- (2) A boy of 8 was admitted 27 hours after an accidental direct hit with a pick axe. A large amount of brain matter was protruding through the wound, and the brain was pulsating. The boy was, however, quite conscious and looked fairly comfortable. The scalp was shaved, sloughing brain matter removed, wound dusted with sulphonamide powder and covered over with flavine gauze. He was given sulphonamides by mouth and he ultimately recovered. Culture of the brain matter showed heavy contamination with bacillus pyocyaneus, gram positive cocci and gram negative diplococci.

In another case of a similar nature however, a child after a period of recovery, developed meningitis and was taken home in a moribund condition. The organisms in this case were probably sulphonamide resistant. Penicillin might have saved the child, but this unfortunately was not available at the time.

#### REFERENCE.

GEOFFREY JEFFERSON—Head Injuries—  
Medical Annual  
1945—pp.135-139.

V. L. Suryavanshi with his experience of a large number of cases of different types of fractures of the skull with various symptoms, gave it as his general impression that in the face of even alarming signs and symptoms it may be possible to save a patient with cerebral compression. He said that all patients with

similar injuries of the skull and the brain may not show identical symptoms showing that the brain does not suffer the same physiological damage in all cases. Referring to the question of opening the durameter Mr. Suryavanshi said that if the dura is found to be tense, if the pulsations of the subjacent brain are neither seen nor felt or if it looks purple indicating a haemorrhage underneath, it should invariably be opened. Where the Surgeon is in doubt as to the exact nature of the trauma and if the general condition of the patient be not grave, it is better in his opinion to trephine rather than go on with hypertonic intravenous saline, lumbar punctures, etc.

V. P. Mehta: Stressed on the need for propaganda to prevent cases due to automobile and other accidents. He referred to the value of pupil and consciousness charts, pupillary changes alone being not always reliable in diagnosis.

Lumbar puncture, he said, should be carried out in all cases and in his series where the C.S.F. tension was recorded with the aneroid manometer the highest recorded was 80 more than normal while the lowest was 40; therapy should aim at restoring tension to normal.

No case of chronic C.S.F. rhinorrhoea has been recorded in a series of 400 cases analysed by him.

R. Nagendran, Mysore, gave a brief outline of the treatment of head injuries in battle casualties.

The Army Medical Department had provided separate centres for treating head injuries.

A person receiving injury to the head was treated by the Regimental Medical Officer by cleaning of the wound and the application of Sulphonamide powder and bandage; A.T. Serum 1500 units was given by injection. In the forward Surgical Unit or the Casualty Clearing Station, the wound was re-examined to see if there was bleeding. Bleeding points were ligated. The wound was dressed with Sulphonamide powder and dressed with gauze and bandage. The wounded person was evacuated by ambulance, ambulance train or by air to the 'Head centre'. Head injuries stood air evacuation very well indeed.



At the 'Head centre', the skull was x-rayed in different positions according to the needs of the case. The head was shaved and under local infiltration anaesthesia, the wound margins were excised. Opening into the cranial cavity was made by suitable trephine holes. Bleeding vessels in the dura were ligated. By means of a sucker all soft brain tissue was removed. No special attempt was made to remove Foreign bodies if any. Then Calcium Penicillin with Sulphonamide was sprayed as a thin foam over the brain and the skin closed as a Primary Closure. The patient was nursed in the half sitting position. Sutures were removed on the 4th or 5th day and in most cases healing took place satisfactorily.

In the Central Mediterranean Theatre Indian patients with large trephine holes in their skull were sent to 15, Scottish General Hospital in the Middle East for closure of the skull defect.

Primary closure of the skull defect was tried successfully in some cases by the use of acrylic plates. These plates could be easily moulded on the skull and could be anchored to the pericranium by holes made on the periphery of the plate. To prevent the formation of a haematoma under this plate, the dura was stitched up to a hole in the centre of the plate, thus avoiding a potential space between the plate and the dura.

# THE TREATMENT OF BURNS WITH SPECIAL REFERENCE TO THE AETIOLOGICAL FACTORS IN SHOCKS AS IT OCCURS IN BURNS

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The question of the adequate treatment of burns, although of great importance in peace time, especially in industrial areas, has assumed very much greater importance of recent years, owing to the enormous number of cases of burns which have arisen as a result of the war, both in the fighting forces, and among the civilian population of the combatant countries.

The result of this has been a fillip to research into the pathology and treatment of burns of all types, and their associated complications. There has also been publication of an immense quantity of literature describing the results of this research. Prominent in that literature have been descriptions of investigations into the most important factors in the causation of deaths following burns, namely surgical or oligæmic shock. It is perhaps in this direction that the most important practical results have been achieved. Progress has been made, and increased understanding obtained, of the aetiology and mechanism of this constant accompaniment of burns. Factors in the production of oligæmic shock, which but a few years ago could only be regarded as theories, have since been placed on a sound scientific basis, and may now be regarded as matters of ascertained fact. An attempt will be made in this thesis to present in a compact form the present state of knowledge with regard to burns and their treatment, to pay special attention to the mechanism of production of shock associated with burns, and to describe the most recent methods of prevention and treatment of that condition.

For this reason undue space will not be devoted to long descriptions, or classifications and types of burns, nor to the highly specialised subject of burns arising from such causes as exposure to X-Rays and chemicals such as mustard gas and lewisite; nor to dealing with theories and practice which have now become, or should have become obsolete. These will

only be included when they have some bearing on the practical issues involved.

## THE CAUSES, TYPES, AND CLASSIFICATION OF BURNS.

Burns in general are caused by the application of heat, or of certain chemicals, to the tissues of the body. Increased industrialisation, the use of electricity, and the introduction of the internal combustion petrol or oil driven engine, have resulted in a great increase in the number of cases of burns in civil life, whilst in the time of war to these are added incendiary bombs, certain types of which contain chemical substances which ignite and burn at very high temperatures, often setting fire to buildings, with obvious risks to their occupants. Others contain phosphorus, which ignites spontaneously, and continues to burn whilst it is in contact with the atmosphere. If any of the combatants in future wars decide to employ chemical warfare, burns from mustard gas lewisite, or some similar chemical may become commonplace. Flame throwers of various types are already in use, and add further horrors to modern warfare. With the exception of the war gases, the effects on the human body of all these different modes of causation of burns are identical, so that time and space will not be wasted in describing them individually.

**Classification of burns.** It is customary to divide burns into major and minor burns, although any such classification is purely arbitrary. The placing of a burn into one or other of these categories depends broadly speaking on two factors. Firstly the extent of the burn, and secondly its depth or degree. As a general rule the extent of a burn is of more practical importance than its depth, as the degree of shock depends very largely on this factor. It therefore has a very important bearing on the prognosis of the individual case. The extent of a burn is as a rule fairly easy to assess with sufficient

accuracy for practical purposes, but for statistical records more accurate methods have been devised, notably by Du Bois and Du Bois, (1) who in 1915 introduced a method of assessing the total surface area of the body, and of any individual part of it, employing certain measurements and constants which they published in the form of a Table.

The academic classification of burns with regard to their depth, is that of Dupuytren, who classified them into six degrees according to the tissues involved. Dupuytren's classification, although useful theoretically, has now given place to simpler classifications, with a more practical application. The essential point about the degree of any given burn, is whether or not the burn has destroyed the whole skin. From a practical point of view, and from the aspect of successful treatment, it is therefore most convenient to adopt the classification suggested by Wakely (2) and to divide burns into two degrees only\*. Any further future reference in this thesis will be to this classification.

1. Burns involving partial skin loss. These include the first and second degree burns of Dupuytren's classification.
2. Burns involving total skin loss, no matter what additional structures are involved. These include the remaining four degrees of Dupuytren's classification.

Most burns of any consequence show areas in which there is partial skin loss, and others where the whole depth of skin has been destroyed. In many cases it is difficult to estimate in the early stages whether a burn is of the first or second degree, although the recognition of fat may be of assistance, but an attempt should always be made, as future progress, prognosis, and treatment will largely depend on it.

### ASSOCIATED COMPLICATIONS AND THEIR AETIOLOGY.

As in other types of trauma, morbidity and mortality from burns arise not so much from the local injury, as from the associated complications of that injury. The usual complications and associated conditions of burns are, in order of their appearance, which is not of course the order of their importance:

- (i) Initial shock.
- (ii) secondary shock.

(iii) post-traumatic hypertension

(iv) toxæmia, with which may be associated sepsis.

These conditions, in greater or less degree, are seen in most burns, of any magnitude. Other rarer complications which may arise are various respiratory lesions, duodenal ulcer, and jaundice, whilst scarring is a common sequel.

(i) **Initial shock.** Shock is no single entity. Differentiation between initial shock arising almost immediately after an injury, and secondary shock, usually manifesting itself within two hours of the injury has long been recognised. In their turn neither of these two conditions is a separate entity and in the case of initial shock various authors have laid stress on different aspects of the condition and have given different names to a group of conditions which are certainly very closely allied. The term in most common use is primary shock. McMichael (3) lays stress on the nervous element in its production and prefers the name of neurogenic shock. The Medical Research Council (4) in "The treatment of Wound Shock" describe a condition, vasovagal collapse, which usually comes on soon after injury, but may occur subsequently, particularly on the assumption by the patient of the upright posture, or as a result of fluid loss or painful manipulation or dressing (\*). It is probable that all these conditions, if not identical, are very closely associated in their aetiology. The sequence of symptoms has been most closely studied following venesection in man.

**Clinical features.** The clinical features are well-known. The patient feels faint, with an alternating sensation of heat and cold. Sometimes vomiting occurs, and very rarely, convulsions. There are signs of lowered blood pressure. At first the pulse is fast, feeble, and of poor volume, but in later stages the pulse rate usually falls to 50-60 per minute. The systolic blood pressure may fall in mild cases to 80 m.m. of Hg. or even less, especially in cases which are associated with a fair amount of hæmorrhage.

Mild degrees of primary shock usually pass off if the patient is kept flat, and more severe cases respond well to treatment by the application of warmth, and relief of pain with

morphia. Of 270 cases of minor burns treated by the present writer following an air raid in 1940, 127 exhibited symptoms of primary shock which passed off with no treatment other than warmth, hot drinks, reassurance, and rest in a recumbent posture.

Nevertheless primary shock has a small mortality, and may account for 2 or 3 per cent. of all deaths from burns and scalds. (5).

**Aetiology.** The precise aetiology of primary shock is still obscure. In some cases the psychological aspect is predominant. In others the condition seems to be the consequence of severe vaso-motor upset caused by the reception of multiple painful nervous impulses from the injured area, and resulting undue stimulation of the sympathetic nervous system which causes constriction of the arterioles of the skin and splanchnic area, but dilatation of the vessels in the skeletal muscles.

It is fairly generally accepted that the fall of arterial pressure is not directly the result of reduced cardiac output, but is due to the vaso-dilatation in the skeletal muscles.

Repeated investigations have revealed no abnormality in the blood chemistry or in the sedimentation rate.

The degree of primary shock depends in part on the extent of the area involved in the injury, and an extensive superficial burn causes more primary shock than a small deep one.

(ii) **Secondary Shock.** Primary shock may pass into a condition of secondary shock, also known as traumatic shock, wound shock or oligæmic shock. On the other hand secondary shock may develop quite suddenly an hour or more after a burn or other injury is sustained.

**Clinical features.** In established shock the following signs are exhibited. The patient's skin is pale, cold, and clammy; the pulse is rapid and thready; respirations are shallow and fast; the temperature is sub-normal; urinary output is diminished, and the arterial blood pressure may show a steady fall, or a pronounced and rapid one. The venous pressure is low. Although the skin is generally very pale, cyanosis in the lips, lobes of the ears and nails may indicate the sluggish state of the circulation. The patient is usually quite

clear mentally, but the expression is usually anxious, and in progressive cases the patient passes eventually into a state of apathy which is followed by death.

Although established shock is easy to recognise, in the early stages of the condition the outward appearance of the patient may be misleading on casual examination, but careful clinical observation will, even in the early stages, reveal a rapid pulse of poor volume which precedes any great fall in blood pressure. As the severity of the condition increases, the blood pressure falls profoundly and the pulse may become imperceptible at the wrist.

Finch (6) says that secondary shock is dangerous if the pulse rate is 120, the systolic blood pressure 60 mm of Hg. or less, and the blood volume 35—50 per cent. below normal.

**Aetiology and mechanism.** The problems of secondary shock in cases of burns are somewhat different from similar problems in other branches of casualty surgery, since shock complicating burns is not as a rule accompanied by much hæmorrhage. Although the subject of much dispute in the past, it is now generally agreed that secondary shock in burns is due to the great loss of plasma from the burned area, and resulting oligæmia (7).

At first, fluid rich in electrolytes, and later fluid rich in plasma protein, escape from the surface of the burn, and, which is more important, into the tissue spaces of the whole of the area involved, through a local increase in capillary permeability (8).

The amount lost from the surface is small in comparison with that lost into the tissues. The condition is therefore really the result of a transfer of fluid from where it ought to be to where it ought not to be. Dunphy et al. (9) in animal experiments to investigate bio-chemical changes in the lymph and serum following burns, came to the conclusion that there is no increase in capillary permeability in regions of the body distant from the burn, and this was later confirmed by Glenn et al. (10).

The state of abnormal capillary permeability which is responsible for the plasma loss in burns commences within an hour or two of the injury and ordinarily continues for from 24 to 40 hours, after which it becomes progressively less (11). An appreciation of this fundamental principle is essential from the point of view

of treatment and its practical application will be considered in the Chapter on Treatment.

Animal experiments have shown that plasma loss is greatest in second degree burns and amounts to over 70 per cent. of the total blood volume in cases where one sixth of the body surface has been involved (12). If fluid other than whole blood is removed from the circulation, the blood which remains will become thicker, that is, there will be a relative increase in the number of corpuscles. This haemo-concentration is greater in shock due to burns than in shock due to other kinds of injury, and estimates of the degree of haemo-concentration provide a useful, though not entirely reliable index of the effects of treatment. The concentration of red cells may reach a capillary count of 9 million cells per cubic millimetre.

The loss of plasma is manifested clinically by a fall in blood pressure, although the fall in blood pressure occurs when the compensatory mechanism of the body which maintains the circulation commences to fail.

The circulation of blood in the human body is maintained by three factors, the force of the cardiac muscle contraction, the resistance in the peripheral vessels, and the viscosity of the blood. Interference with these factors is liable to produce a fall in blood pressure and ultimately circulatory collapse, and interference with any one of them produces compensatory reactions in the others. When the volume of blood is considerably reduced, either by haemorrhage or by exudation of plasma into the tissues, the venous side of the circulation is at first affected more than the arterial. Pressure in the great veins near the heart is lowered which results in imperfect filling of the heart and consequent reduction in its output. (Starlings law).

This is followed by decreased pressure in the carotid sinus, with consequent acceleration of the pulse and compensatory sympathetic stimulation, with vaso-constriction, sweating, and skin and visceral pallor.

This mechanism becomes operative when the systolic blood pressure is reduced to about 80 m.m. Hg. and if the blood pressure is allowed to become reduced by another 20 m.m. Hg. collapse of the circulation ensues (13).

The relation between the clinical condition and the degree of blood volume reduction has

not yet been perfectly defined, but it is known that a reduction of 25 per cent. in blood volume may be associated with only slight symptomatic disturbance. Losses greater than this are likely to produce a considerable decrease in blood pressure and when 50 per cent. or more of the blood volume is lost the fall in systolic blood pressure is often to below 60 m.m. Hg. (14). More accurate methods, the result of further investigations, may at some future date result in the measurement of blood volume or the specific gravity of the peripheral blood furnishing a reliable indication of the degree of shock in individual cases.

In cases of secondary shock, if the lost blood volume is restored quickly and completely, the symptoms described above pass off, and recovery results. If, however the condition has been left untreated for several hours, restoration of the blood volume may have a disappointing result, and recovery not take place. In these cases haemo-concentration and other signs of shock persist until death supervenes, which is usually between 20 and 30 hours after the original injury.

The causes of this irreversible circulatory failure are still the subject of much discussion. It is possible that prolonged anoxia damages the vital centres in the medulla. Damage to the cardiac muscle, the result of poor coronary blood supply, may also be a contributory factor. Wiggers (15) is of opinion that there might be some as yet unidentified factors such as changes in the adrenal cortex, translocation of potassium, or some other unknown cause of vaso-motor failure.

Besser (16) supports the view that the adrenal cortex protects the organism against shock on the grounds that removal of the adrenals, or even adrenal insufficiency produces a condition similar to shock. There is also increase of cortical hormone in the urine of shocked patients, and discharge of lipid granules from the cells of the adrenals in conditions of shock and circulatory failure. He concludes that the adrenal cortex regulates the electrolytic balance, permeability of the capillary walls, and consequently the volume of circulating plasma. The function of the adrenals in the causation of shock is, however, still uncertain, although further research may well show that they are the key to the whole problem.

On the basis of findings up to the present, however, Desoxycorticosterone acetate has been used clinically in a small number of cases (17). It appears to be of little use in established shock, but is said to prevent the onset of post-operative shock if given in the pre-operative period and continued for two days afterwards. The expense of these preparations at present precludes their trial on an extensive scale.

It was formerly thought by many that destruction of protein and absorption of histamine bodies was responsible for shock. It is generally agreed that the onset of shock may coincide with the release of a tourniquet, which apparently must result in the setting free of some toxic substance into the circulation. Perfusion experiments with blood from an injured limb, however, have not given the same results. Post-mortem appearances in death following known histamine shock show intense congestion of the intestines whilst in traumatic shock the intestines are bloodless. The evidence for histamine as the substance responsible for the onset of shock is therefore far from convincing.

From the foregoing it will be realised that although much research and analysis of chemical and pathological data has been carried out in connection with the aetiology of secondary shock, much still remains to be done before we are able to say that its causation is so completely understood that its treatment can be formulated on a completely rational basis.

(iii) **Post-traumatic hypertension.** It has already been indicated that blood pressure readings are of vital importance in the estimation of shock. They are, nevertheless, not to be implicitly relied upon, as cases are not infrequent, where a patient has sustained severe burns and is undoubtedly in a state of shock, yet the systolic arterial blood pressure is comparatively normal, or even raised (18). Such cases often develop acute circulatory collapse later, and frequently with little or no warning. In some instances the syndrome may occur in patients who had a high blood pressure before they became casualties, but in others there is little doubt that the relatively high blood pressure is due to vaso-constriction occurring simultaneously with the decrease in blood volume as a result of hyper-secretion of adrenalin. It follows that in severe burns

complete reliance should not be placed on the blood pressure level, but rather on the nature and severity of the injury.

(iv) **Toxaemia:**—In cases of burns, particularly those who for some unavoidable reason have not received adequate treatment in the early stages, a condition of intoxication is liable to occur from 48 hours to 10 days after the injury. The onset is usually insidious, but may be fulminating. There is often vomiting; the patient becomes irritable and distressed, complaining of headache and loss of appetite, with which are associated a high temperature and a rapid pulse. Urinary output falls, stupor develops, and may gradually deepen into coma. The temperature continues to rise, and death often occurs with hyperpyrexia.

In many cases, bacterial infection of the burn has undoubtedly taken place in the early stages, and in these cases the actual burned area becomes frankly septic, and exudes seropus. But in others sepsis can be excluded with reasonable certainty, and these cases are very difficult to account for. Many workers, including Davidson, (19) have suggested that the condition is due to some toxin formed at the site of the burn by the formation of a high protein derivative resulting from autolysis of the injured cells.

In 1938, Wilson, MacGregor, and Stewart (20) described post-mortem degenerative changes in the viscera and particularly in the liver which lent weight to this hypothesis, although they also pointed out that toxaemia was more common and severe in burns treated with tannic acid than in those treated by other methods.

More recent work, however, indicates that severe necrosis of the liver after burns probably occurs only with tannic acid treatment and results from absorption of tannates (21). The evidence for toxic absorption from burns in general has therefore to a certain extent been discounted. At the same time it must be conceded that occasionally these symptoms have occurred with forms of treatment other than by tannic acid. Treatment of toxaemic symptoms in the absence of obvious sepsis therefore remains to a certain extent empirical.

The prevention of septic toxaemia lies in adequate treatment in the early stages, and this is all the more important since if sepsis becomes well marked, septicaemia and pyaemia often supervene.

The introduction of chemo-therapy has reduced the incidence of septic toxæmia, but it still remains a serious contributory factor to deaths from burns, especially in cases where, from unavoidable reasons, prompt and adequate treatment has not been possible.

**Undue scarring and contractures:**—These are complications which in the majority of instances are preventable by proper and careful treatment, but still occur far more frequently than they really should. The condition may vary from the mere presence of a puckered unsightly scar, to severe deformity the result of muscles, tendons and joints becoming fixed in an abnormal position.

There is little difficulty in the prevention of undue scarring in burns with only partial skin loss. If there has been extensive and total skin loss, however, severe scarring is likely to result unless the burned area is skin grafted immediately it becomes covered with granulation tissue. Sepsis if allowed to develop leads to the formation of further connective tissue arising from the inflammatory processes.

The mechanism of the production of contractures varies, and it is not only in burns in which muscle has been actually involved that severe contracture is liable to occur. After burns, or indeed any other form of trauma, joints tend to assume the position of greatest ease. At the same time muscles adjacent to a burned area tend to contract thus releasing some of the tension on the burned surface. Such a muscle or tendon may become fixed to its surrounding sheath by the organization of even a slight exudate, and unless steps are taken to prevent it they will become fixed in an abnormal position. In other cases muscles and tendons which have long been fixed in an abnormal position, though they may not have been damaged in the original injury, become permanently shortened. In more extreme cases of this nature, the ligaments on the flexor aspects of joints may become shortened and in some instances intra-articular changes may even take place. These latter conditions, although they should really never arise, are extremely serious if they do, as they obviously cannot be cured by any cutting away or other treatment of the overlying scar, and restoration to normal function becomes impossible. The occurrence of these catastrophies is probably more frequent in burns than in other forms of trauma, since burns, owing to the

relatively greater interference with cell nutrition from venous and lymphatic thrombosis take much longer to heal than raw surfaces of similar extent caused by other forms of injury. The necessity of bearing this in mind during the early stages of treatment needs no stressing. The mere covering of a burned area with a newly formed skin surface should not be the criterion of cure, and no end result should be regarded as satisfactory unless there is complete restoration of function of the injured part.

**Respiratory lesions:**—In burns involving the anterior aspect of the trunk and face, and especially if the patient has been enveloped in flames, or has breathed very hot air following explosion in confined spaces, bronchitis, broncho-pneumonia, and pulmonary oedema are liable to ensue. There may also be inflammatory changes and even sloughing of the linings of the upper respiratory passages.

These complications, when they occur, are all of serious import, and the prognosis is exceedingly grave.

### General Principles of Treatment.

For purpose of description of methods of treatment it is convenient to classify burns into major burns and minor burns, although such a division is of course only arbitrary. The following definitions cover the essential points.

Minor burns are those in which the burn is of the first degree. Not more than one per cent. of the body surface is involved, that is in the adult an area corresponding to about the area of the palmar surface of the hand, or about 28 square inches.

Major burns include all burns involving more than one per cent. of the body surface, and all second degree burns, that is, burns in which the whole thickness of skin has been involved. Most burns of the face, hands, and limb flexures should be regarded as major burns, irrespective of their degree.

**First Aid Treatment.** The most important object of first aid treatment in the case of burns in general is to prevent shock. In major burns no attempt should be made to diagnose the extent or degree of the burn. The patient should be reassured, kept warm, given warm drinks, and sent to hospital on a stretcher with as little delay as possible. If the affected area

is exposed it should be covered with a clean or preferably sterile dressing. The application of any preparation such as ointments, cold tea, oil, flour, etc. does not help the patient and adds considerably to the difficulties of the surgeon later.

In minor burns the same general principles apply, but hospital treatment will not be necessary and the patient can be treated by a doctor, either at home, at a surgery or dispensary, or in an O.P. Department.

**Minor burns** For any except the slightest of burns, a hypodermic injection of morphia is helpful. The burn should then be thoroughly cleansed with gauze swabs wrung out of sterile saline. Blisters should be opened with sterile scissors. Further treatment is then a matter of individual choice, and a whole range of jellies, ointments, and other preparations is available.

A solution of picric acid was formerly a great favourite in the treatment of burns, and is still in very common use in first aid posts and factories.

This drug reacts with the albumens of the burned surface and forms a slight eschar. It has the great disadvantage that it is liable to set up a condition of dermatitis in the skin surrounding the burn, and cases have been reported in which absorption and reaction to picric acid have resulted in the death of the patient. The present writer has seen many cases of dermatitis of a most intractable character following the use of picric acid and consequently gave up its use as far back as 1923.

Much to be preferred is to cover the burned area with one of the many coagulant jellies, of which triple dye jelly, (Gentian violet 1%, Brilliant green .1%, euflavine .1%, with 5% sulphadiazine in a water soluble base) is probably the best. This jelly, which should be liberally applied on two separate layers of gauze, causes coagulation and produces a soft, pliable eschar. The burn should be inspected on the second day, and if satisfactory the dressing should be left undisturbed until the separation of the tan after 12 to 14 days. If moist areas are found after 48 hours, the overlying gauze is cut away and fresh jelly applied. If fresh blisters develop they should be cut open and the raw surface treated in the same way.

Tannic acid and other burn jellies are also used, but in the experience of the writer, none of them is as satisfactory as those containing the aniline dyes.

Colebrook has obtained good results from a sulphonamide cream designed to prevent sepsis of the burned area and which is easily removable should more complete treatment in hospital prove necessary.

The treatment of superficial burns with micro-crystalline sulphathiazole has been carried out in the U.S. Navy Medical Corps. The powder is applied with an insufflator the burn having been previously thoroughly cleansed. The burn is then covered with sterile gauze and the whole tightly bandaged. Dressings are renewed every third day.

Recently the use of paraffin wax as a treatment for burns has been resuscitated by Lt.-Commander R. C. Pendleton (22) of the U.S. Navy Medical Corps. A mixture of paraffin wax, vaseline cod liver oil, and sulphanilamide, with traces of camphor, menthol and eucalyptus oil is sprayed on to the burned area from a flit gun. No bandage is applied. The wax film is washed off the burn daily with warm water, and renewed. The burn is not cleaned before the wax is applied, although it may be dusted with sulphanilamide powder.

The present writer in 1924 treated a series of over a hundred cases of minor burns by the application of Paraffin No. 7, which is a preparation of paraffin wax with a melting point of 48 degrees Cent., and has used the same method of treatment in suitable selected cases regularly since.

The treatment is suitable for first degree burns not too large in area, but the presence of patches of burning of the second degree is not a contra-indication where these are not too large.

The burn is first cleansed with warm water and afterwards swabbed with 1 in 1000 acriflavine solution. It is then carefully and thoroughly dried by dabbing with plain sterile gauze. The wax, which has been previously melted in a water bath is then painted on with a soft brush. A fair sized shaving brush is most convenient since it is preferable to get the wax applied as quickly as possible. The first coat is allowed to become hard, which takes place



in a few seconds, and a second coat is applied. A third coat is applied in the same way and finally the whole covered with sterile wool and loosely bandaged. After 24 hours the dressing is removed, when it will be found that the wax has been lifted from close contact with the burned surface by the exudation of serum, and can easily be removed with forceps. After drying, a fresh wax dressing is applied as before. The treatment is continued in the same way but after 4 or 5 days it will be found that it need only be renewed at 48 hourly intervals. Contrary to what might be expected the dressings are not painful, sepsis does not occur, and healing is extremely rapid. The greatest advantage, however, is the nature of the scar, which is always firm and supple and in the opinion of the writer, superior to the scar resulting from any other form of treatment. The disadvantage is that if a large number of burns has to be treated at one time the method is slow. Nevertheless the cosmetic results are so good that it remains the writer's treatment of choice in burns of the forearm or small burns of the face in women and girls where the cosmetic result is a matter of considerable importance.

**Major Burns:**—It should be accepted as a universal rule that all major burns should be treated in hospital. In serious cases, complicated by shock, management and adequate treatment are impossible, otherwise, and even in less serious cases complications are liable to arise in connection with the long process of healing which may demand expert supervision, and trained and skilful nursing, which are virtually impossible to obtain outside a properly equipped hospital.

Moreover, if a large number of burns has to be treated, it is preferable that a special ward and theatre be set aside in the hospital exclusively for purposes of burn treatment, partly for convenience of organization of surgical and nursing staff, and partly as a means of lessening likelihood of sepsis through cross infection. Sepsis is a most dangerous complication of burns, and steps to prevent it must be taken from the outset. Cross infection from one patient to another must be eliminated, so medical officers and nurses must be surgically clean and wear masks while dressing burn cases in the wards.

The hospital staff dealing with burns should wherever possible work as a self-contained

unit, accustomed to each other's routine, and all thoroughly familiar with the modern principles of the treatment of burns. A nursing staff fully acquainted with the nursing of burn casualties will become accustomed to the significance of changes in the condition of the patient which may not be apparent to the less efficiently trained, and the vigilance of such a staff will without doubt save the lives of many of these unfortunate people who would otherwise die.

In a modern burns ward a really efficient supply of electric power is an absolute necessity, since every bed should have a shock cage fitted with thermostatic control.

As a large proportion of cases will require intravenous fluids, ample provision for their rapid administration must be provided. Regular blood pressure readings, records of pulse, temperature, etc., will have to be taken and charted so that more nurses will be required than would be necessary for a general surgical ward with the same number of beds.

#### Anaesthesia in burn casualties.

It is an axiom that every extensive or severe burn requires complete surgical cleansing, which will very often necessitate a general anaesthetic. A general anaesthetic also enables the surgeon to make a very complete examination of the burn, and allows him to investigate the possibility of other injuries.

It is felt that a full discussion of anaesthesia in burn casualties is not necessary in this thesis, but some of the more important practical aspects will be briefly indicated.

The administration of a general anaesthetic in a severely shocked patient is a matter calling for great skill and judgment and the anaesthetist should if possible examine the patient at the same time as the surgeon and decide in consultation with him what pre-medication, if any, is required, and what method of anaesthesia is best adapted to the needs of the individual case. Atropine gr. 1/150 with or without morphia according to the degree of respiratory depression may be injected intra-venously immediately before beginning the anaesthetic.

The responsibilities of the anaesthetist are greater in the shocked cases seen in casualty surgery than in normal surgical routine. Move-

ment of the patient on the table, for instance, must be restricted to the minimum possible, and ensuring that the patient is kept warm becomes absolutely essential.

Blood pressure and pulse records should be kept if at all possible, and the closest possible watch kept on such symptoms as pallor, sweating, or delayed capillary return.

An intra-venous drip should always be kept ready for immediate use to avoid any possible delay in the event of the onset of sudden collapse.

**Spinal anaesthesia:**—The blood pressure of a patient suffering from shock associated with burns will already be low. Anything tending to lower it still further will increase cerebral anaemia to an extent which may depress the vital centres to a degree incompatible with life.

The early stages of spinal anaesthesia are associated with a fall in blood pressure, although the fall is due to causes quite different from those operating in shock. (23) The shocked patient is not in a position to suffer this additional fall in blood pressure and spinal anaesthesia in such cases is therefore completely contra-indicated.

**Regional nerve block anaesthesia.** In theory this perhaps is almost the ideal method. In order to ensure complete blocking of sensory stimuli, however, very large quantities of analgesic agent are required in cases where the burns are multiple, or extensive in area, and this operates against the general utility of this type of anaesthesia. Its use is therefore restricted to suitable cases, but for such cases, where the surgical team is familiar with the method, regional nerve block anaesthesia must be recognised as of the highest value.

**Intra-venous anaesthesia.** Where an anaesthetist fully conversant with its use is available, this type of anaesthesia has its advantages. By use of an intra-venous drip, barbiturates may be administered over a fairly long period, but in such cases it is almost essential from an anaesthetic machine, or with a B.L.B. to give oxygen throughout the operation either mask. This detracts from the practical value of the method except in cases where short administration of from 5 to 10 minutes are sufficient to complete whatever procedure is necessary. In these cases in particular it should

be remembered that susceptibility to all anaesthetics is greatly increased in cases of shock.

**Inhalation anaesthesia.** Inhalation anaesthesia is suitable for cases of burns except when the burns are accompanied by "blast" injury to the lungs. In these cases avertin anaesthesia, which is not contra-indicated in cases of shock, is most valuable. Deep anaesthesia is not necessary and the amount of anaesthetic used should be as little as possible. Chloroform should be avoided owing to its toxic action on the myocardium, especially in patients with anoxia. Nitrous oxide is excellent but should be used with not less than 20% oxygen. Aether may be used in more severe cases, if possible with an Oxford Vaporiser which facilitates more accurate dosage.

In patients suffering from shock, at least 20% of oxygen should be given in any anaesthetic mixture and this should be increased to 30% or more in the presence or respiratory depression. If respiration is depressed 5% CO<sub>2</sub> may be added.

It should be borne in mind that in pallid subjects anoxia may not be revealed by cyanosis of the skin, although the mucous membranes may be cyanosed.

If a patient has been given a high proportion of oxygen during the operation, this should be continued for some time after leaving the theatre, and the anaesthetist should personally supervise the transfer of the patient back to the ward, and give a report on the patient's condition to the resuscitation team, or other personnel responsible for his further treatment.

## THE TREATMENT OF OLIGAEMIC SHOCK.

Secondary shock accounts for about 80 per cent. of deaths from burns, so that the treatment of burns from the point of view of saving lives largely resolves itself into the treatment of secondary shock.

A patient in a state of severe shock from burns is in urgent need of reassurance, rest, warmth, relief of pain, and fluid to replace the plasma loss. To these may be added oxygen, although this is debatable, and will be more fully discussed later.

As in so many other clinical conditions, it is to a certain extent true to say that the best treatment is prevention. Many actions which are quite easily avoidable may hasten the onset of, or increase shock, and these should never be allowed to occur now that the pathology of shock is more completely understood. Exposure of the patient to cold, rough and careless handling, exposing the entire surface of a large burn at one time to allow unnecessary inspection, cleaning the affected area with spirit or aether, which are cold and irritant, are all procedures which can be avoided with a little forethought. Plasma loss in injured tissues is greatly increased by movement. Complete rest is therefore essential.

Where the nature of the injuries permits, pillows should be removed, and the foot of the bed raised a foot or so, which simple procedure will often raise the blood pressure by 5 to 15 mm. of Hg. In this way the blood supply to the vital centres is assisted, although the measures cannot be used in a patient with head injuries or chest complications.

Reassurance is very important in frightened and anxious patients, as the element of fear is a definite factor in producing and increasing shock.

Warmth can be ensured by the use of hot blankets, electric pads, hot water bottles and warm sweet tea. The latter assists in restoring fluid loss in cases where dehydration is contributing to shock, which occurs more frequently than is generally realised. Blankets used to cover a burn casualty should if possible be sterilized, since the risk of infection of a newly burned area is very great. All casualties who are not unconscious, or suffering from abdominal injury should be given warm drinks freely. If vomiting is troublesome as it often is in burn cases, they should sip the fluid.

The general organization of the reception side of the hospital should be reviewed, and all possible steps taken to ensure that patients are dealt with as expeditiously as possible thus ensuring that they do not get chilled whilst waiting in draughty rooms and corridors. The temperature of all treatment rooms should be kept high; certainly not below 90 degrees Fahr.

Blacklock and Mason (24) have described the dangers of overheating the patient in cases of shock, and state that this may result in the

transfer of as much as half a litre of blood to the skin vessels. Heat should be applied gradually but adequately so as to maintain the temperature of the patient at 98.4 degrees. Heat cages, unless they can be thermostatically controlled are a source of danger and as a general rule it is probably preferable to rely on simpler methods readily available.

The relief of pain is of fundamental importance, and calls for morphine to reduce the afferent impulses passing to the central nervous system. Morphine should not be given as a routine measure since in the past, many people who have been given  $\frac{1}{2}$  gr. as a routine soon after injury have subsequently died of increased anoxia and respiratory depression. Its use should be reserved for cases complaining of pain. It should not be given subcutaneously on account of the slow rate of absorption in shocked patients and the risk, if supplementary doses are given, of absorption of large quantities of morphine quickly when the circulation improves. Intra-muscular injection is often sufficient, but probably intravenous injection of one-sixth to one quarter of a grain, injected over a period at least a minute, is preferable. Pain is often not complained of until the circulation is recovering during transfusion, and in such cases the injection may be made direct into the circulation through the rubber tubing of the transfusion set.

The essential feature of the use of morphine is that it should only be given for the relief of pain, and that when necessary to relieve pain it should be given in sufficient doses. Wakeley goes so far as to say that "morphine will never kill a patient who is suffering severe pain." All these measures, although very necessary, are nevertheless of much less importance than the restoration of the lost plasma fluids. In our present state of knowledge this is our sheet anchor in the treatment of shock, whatever may be the cause, and where the state of shock is deep, it is the only measure which will save the life of the patient.

Life can only be maintained by the continuance of an adequate blood volume. The mechanism of circulatory failure which follows on reduction of blood volume has already been described. Only when the volume of circulating blood is adequate can efficient oxygenation of the vital centres take place.

**Pressure dressings:**—There is considerable evidence in favour of the view that loss of

circulatory fluid can be considerably reduced by the application of some form of pressure dressing. This should be applied as early as possible and certainly within a couple of hours of the time of injury. Care must be taken that the dressing is so applied, and constant supervision and inspection must ensure, that the dressing thus applied does not impede the circulation. In cases of burns of the hand or forearm, elevation of the limb well above the level of the heart assists in lessening or preventing oedema.

**Salines:**—It was formerly believed that intravenous saline, or glucose, or gum saline infusions were suitable methods of restoring blood volume to normal. In certain types of injury, for example in severe abdominal injuries where dehydration complicates the condition, intravenous saline may be used in limited quantities to supplement previous transfusion, but this clinical picture is of course never seen in uncomplicated burns.

It is true that intravenous salines do make up the blood volume, but being electrolytes, they pass rapidly into the tissue spaces, and are quickly excreted; so that their effect is very transitory and their practical value negligible (25). Moreover in cases of shock, if sufficient saline is transfused to raise the blood pressure to normal, such a degree of dilution of plasma proteins ensues that the late tissue changes are actually accentuated (26). Glucose contained in glucose saline, not being a colloidal substance, also passes very rapidly from the active circulation, and may lead to pulmonary oedema.

Gum acacia solution, formerly much used, is now almost completely out of favour. It is said to interfere with gaseous exchange and may cause fatal reactions as a consequence of hepatic damage (27). Saline preparations, therefore, have a very limited place in the treatment of shock from burns.

**Transfusion of serum or plasma:**—This is now by far the most important single method of treatment of shock arising from burn injuries. Whole blood transfusion, whilst remaining the ideal method of treatment in injuries accompanied by haemorrhage, is contra-indicated in burns, since it does nothing to reduce the haemo-concentration which has been shown to be a feature of shock in burn casualties as distinct from other forms of injury. Moreover,

pooled plasma has the immense practical advantage that compatibility tests are not necessary, since iso-agglutinins are partially suppressed by pooling, and further inhibited by the patient's blood.

Unlike electrolytes, the protein constituents of plasma neither pass into the tissue spaces, nor are they otherwise excreted, so that by transfusion of plasma the blood volume is both restored and maintained.

There are various methods of preparation of preserved and dried plasma and serum which it is not proposed to describe, although in practice it is desirable to know by which process a given bottle of plasma has been prepared, since filtered plasma may be stored at room temperature, whilst non-filtered plasma should be kept in a refrigerator. Dried plasma has some advantages from the point of view of storage, and is probably less likely to grow organisms.

There is still some disagreement as to the relative merits of serum and plasma. Levinson (28) prefers serum as it is easier to filter and store than plasma, and there is no separation of fibrin. Strumia (29) advocates plasma because of the possibility of reactions following the use of serum, Best and Solandt (30), are of opinion that serum and plasma are generally speaking therapeutically interchangeable. Filtered serum might have some advantage in hypo-proteinaemia since it contains 7 per cent. of dissolved protein as against 4.5 per cent. in citrated plasma (120 cc. citrate, 220 cc. plasma) (31). To avoid repetition, so far as this thesis is concerned, the use of citrated plasma will be described, but serum may of course be substituted.

**Indications for plasma transfusion:**—From what has already been said, it will be clear that restoration of blood volume will only be maintained if sufficient plasma proteins are returned into circulation, thus correcting the disturbed balance of intra-vascular and extra-vascular fluids, and restoring normal osmotic pressure relationships.

It may be taken that as a general rule every patient with a systolic blood pressure of less than 90 mm. Hg. should be given plasma and this should be continued until the systolic blood pressure is at least 110 mm. Hg. The transfusion should then normally be continued by slow drip for another 24 hours at least.

At the same time the blood pressure reading is by no means an infallible guide. If a patient has severe burns, but the blood pressure remains normal, skilled clinical judgement may be required in coming to a decision whether to transfuse or not. If there is any doubt, it is far safer to give plasma than to wait for urgent symptoms to arise. No matter how desperate the condition of a patient may appear to be within 36 hours of injury, transfusion should be started at a rapid rate, as cases are on record where apparently moribund casualties have been resuscitated by massive transfusions of plasma.

**Quantity and rate of transfusion.** As a primary measure, Harkin recommends that in burns deep enough to cause blistering, 50 cc. of plasma should be transfused for every 1 per cent. of the body surface burned i.e. roughly a pint of plasma for every 10 per cent. of the body surface affected.

Many methods have been devised to estimate the quantity of plasma which it is advisable to give in cases of burn shock, but perhaps the most useful are those which depend on the estimation of the degree of haemo-concentration or the volume occupied by the red corpuscles in a centrifugalised sample of a standard quantity of blood, which is estimated by means of a haematocrit tube.

Black, (32) in 1940, described a method of estimating plasma deficiency based on the assumption that the haemoglobin is 100 per cent. and the blood volume 5 litres, of which 3 litres are plasma. Since the red cell volume remains unchanged, the increased haemoglobin value observed bears the same relation to the initial value, as the initial value for blood volume bears to the new volume. The formula is:—

$$\frac{\text{Hb}}{100} = \frac{5}{5-x}$$

where Hb is the observed haemoglobin value after the burn and x is the amount of plasma lost. This method is liable to error if the patient has not an original blood haemoglobin value of 100 per cent. so that the final criterion must be based on judgement and experience.

Harkin (33) recommends that 100 cc. of plasma should be transfused for every point the haemastocrit exceeds the normal of 45. If

the plasma proteins are low an additional 25% should be added to the calculated amount for every gramme by which the protein level is below 6 grammes per 100 cc. This method also assumes that the original haematocrit reading of the patient was normal, and the average adult weight is 70 Kgm. The amount of plasma given must be corrected on a weight basis for small adults and for children. The normal plasma protein level is 6.5 to 9 gm. per 100 cc. of blood and any level below 6.5 can be regarded as hypo-proteinaemia. The critical level of plasma protein, that is the level at which oedema begins is given by Moore and Van Slyke (34) as 5.5 gm. per 100 cc. A method for estimating plasma protein is given by Taylor and Gibbons (35).

A useful method of assessing the degree of shock based on an estimation of blood volume has been devised by Bushby, Kekwick and Whitby (36). It depends on the fact that when a known volume of plasma is added to the unknown volume of circulating blood the total of red blood cells remains unchanged. The haemoglobin percentage as expressed by the haematocrit packed cell reading can therefore act as an indicator of the amount of dilution brought about by the transfusion, and provided the observations on the red cells are carried out before, and immediately after, the transfusion of a known volume of plasma, the blood volume of the transfused subject at the time the transfusion is commenced can be determined by a simple calculation. The plasma should be transfused quickly and in this connection Marriott and Kekwick (37) have pointed out that transfusion in cases of severe shock should be at the rate of one pint per 15 minutes or even faster. The method is particularly suitable for shock in cases of burns since the results are generally not in danger of being vitiated by bleeding taking place. The formula for estimating the blood volume is:—

$$V = \frac{P \cdot y}{x - y}$$

where

P = the volume of plasma transfused.

x = the haematocrit reading before transfusion.

y = the haematocrit reading after transfusion.

The normal blood volume in adults is stated to be 40 cc. per pound of body weight and in children and infants about 41 cc. per pound.

The method of Bushby et al. has the great advantage that the patient is not kept waiting for treatment whilst estimates of the correct amount of fluid to transfuse are being made.

Although these recently devised methods of estimating the degree of shock are without doubt based on scientific principles and may in future come into universal use, their practical value is at present by no means universally accepted. Moreover they demand skilled technicians and laboratory equipment which is far from being universally available. It is perhaps true to say that in our present stage of development repeated blood pressure readings and pulse and temperature records are the most practical methods at our disposal. A sphygmomanometer cuff should be left in position and readings frequently taken in all cases of shock under treatment.

The volume of plasma to be transfused should be determined by the response of the patient and the aim should be to restore the blood volume to normal as quickly as possible. In severe cases up to 100 cc. per minute may be given by gravity through a large transfusion needle or cannula until the systolic blood pressure has risen to 110 mm. Hg. when it may be reduced to a drip for 24 hours or more. At this stage the rate of transfusion should not exceed .5 cc. per pound of body weight per hour (38).

In adults with extensive burns as much as 7 to 8 litres of plasma in the first 30 hours have been required to correct haemoconcentration, but the giving of such quantities requires constant watchfulness to prevent pulmonary oedema, although this is not likely to occur provided the infusion rate is slowed after a normal blood pressure level is reached (39).

Apart from the possibility of giving too little plasma in cases of burn shock there is also the very real danger of giving too much and causing the volume of plasma in circulation to rise unduly. This complication is most likely to occur after about 36 hours in severe cases of burns which have been transfused with large quantities of plasma, and is probably due to re-absorption of fluids when the injured capillaries regain their normal permeability.

If the urinary output is low, and especially if transfusion is continued, there is risk of pulmonary oedema which is increased in cases where the air passages themselves have been damaged by the inhalation of smoke or hot gases, or the patient has been subjected to "blast."

**Concentrated plasma:**—Many workers have advocated the giving of plasma concentrated from two to four times, in the treatment of oligæmic shock (40). It would appear to be a rational procedure since if the modern conception of the mechanism of shock is correct, transfusion of concentrated plasma should result in the passage of fluid from the tissues back into the blood stream (41). Muirhead (42) has used plasma concentrated three times which, since it is too viscid to be given by a drip method, he injects with a syringe in doses up to 100 cc. as rapidly as possible, and in quantities up to 900 cc. in a few hours. As compared with massive transfusion of ordinary citrated plasma, concentrated plasma has the advantage that there is no danger of causing pulmonary oedema.

**Technique of plasma transfusion.**—A full description of the technique of plasma transfusion is felt to be outside the scope of this thesis, but one or two practical points will be indicated.

It is far better to tie a cannula in the vein than to use the standard hollow needle, although it is true that is not as important in plasma as in whole blood transfusion. In shock the veins are collapsed and it is often most difficult to gain entry. Even if entry is gained there is always a chance of the needle becoming displaced, with very unfortunate effects.

The cannula is best inserted into the median cephalic or median basilic vein in the arm, the long saphenous vein in the leg, or in the external jugular vein. On very rare occasions no vein may be available and in such cases transfusion of plasma may be made into the bone marrow of the manubrium, or the body of the sternum midway between the angle of Louis and the xiphisternum. The rate of flow by gravity attainable by this route is up to  $3\frac{1}{2}$  c.c. per minute (43).

In all plasma transfusion the strictest aseptic precautions must be maintained

throughout the whole procedure since plasma forms an ideal culture medium for organisms. Any plasma which contains evidence of haemolysis of red cells should not be used if the colour of the plasma is more than the faintest pink. Transfusion of plasma should never be followed immediately by whole blood, as this may result in severe reaction caused by heterologous agglutinins.

**Plasma substitutes:**—Efforts to find some substance which is suitable in every way for use as a substitute for human blood are constantly being made.

Hamilton Bailey (44)<sup>1</sup> says that German chemists have prepared a synthetic colloid which is well tolerated, and is said to maintain the blood volume for two days and become completely excreted in from two to three weeks.

Pure bovine albumen with the same osmotic pressure as human plasma has been prepared and used successfully in human casualties without producing reactions.

Animal experiments have been conducted in Sweden with solutions of pectin suitably buffered with sodium chloride and phosphate.

**Administration of Oxygen:**—Perhaps in no other aspect of the treatment of shock is there so much disagreement as in the value or otherwise of oxygen therapy. Human blood is normally 95 per cent. saturated with oxygen, and its administration to a healthy person will not increase significantly the amount of oxygen in the blood. In the type of anoxia which occurs in shock the oxygen content of the blood is normal but the tissues are not able to take it up in sufficient quantity by reason of the slow blood flow. It is therefore difficult to understand how oxygen therapy can affect this type of anoxia one way or the other.

Clinically it has long been considered that morphia lowers the blood pressure and oxygen restores it. Since many shocked casualties have been given full doses of morphia, they may in theory be given oxygen with benefit, and clinically it has been shown by Melton (45) that efficient oxygen therapy, giving 6 to 8 litres per minute, causes a rise in blood pressure of 20 mm. of Hg. or more, which is not maintained when the administration of oxygen is discontinued.

These findings were not borne out by Frank and Fine, (46) who found that the course of

events in uncomplicated shock was in no way altered by oxygen therapy.

The authors of "The treatment of wound shock" (47) consider it unwise to recommend oxygen therapy in addition to transfusion and are of opinion that it should be relegated to its appropriate place, "when injury to the chest has led to interference with respiratory oxygen uptake, or where there is pulmonary oedema." In such cases of course there can be no doubt of its value, since due to the interference with ventilation the haemoglobin does not become saturated and the arterial blood becomes venous in character.

If oxygen is used it is a *sine qua non* that it must be used continuously and efficiently. It is said that even when 90 per cent. of oxygen is present in the lung alveoli it only increases the amount of oxygen carried by the blood by ten per cent. The complete futility of any method of oxygen administration which does not result in a very high concentration of oxygen in the alveoli is therefore obvious. The B.L.B. mask, by which the alveolar concentration can be accurately controlled is the most efficient, although delivery through nasal tubes with spectacle frame, or by Marriott's (48) method of fitting a football bladder to an anti-gas respirator is also quite satisfactory as an emergency measure. In all methods the oxygen should be passed through water in order to humidify it.

There is undoubtedly scope for further research into the value of oxygen in the treatment of oligæmic shock, and also for improvements in and simplification of the methods of administration.

On the whole, however, clinical experience suggests that it is of value when properly administered, and in the odd case may be the determining factor in saving a patient's life.

**Pressor substances:**—Great hopes were formerly raised that desoxycorticosterone acetate would prove a great life saving agent in treatment of shock. Its action is not completely understood. It is known that in shock there is disturbance of the normal balance of sodium and potassium ions in the blood serum the potassium being increased and the sodium decreased the sodium being presumably lost into the injured tissues. Natural supra-renal hormone, cortin, and the synthetic product,

## TREATMENT OF BURNS

desoxycorticosterone acetate, appear to mobilize sodium from an unknown source and enable the blood serum to retain this sodium in circulation (49).

In practice their use is said to prevent the onset of post operative shock if given in the pre-operative period and continued for two days afterwards, but in cases of established shock reports are very conflicting, and their value is at present far from being established.

**Cardiac stimulants:**—Cardiac stimulants raise the blood pressure and increase the force of the heart beat for a short time but since shock is not a condition primarily affecting the heart or the cardiac centre there is no very definite indication for the use of cardiac stimulants.

**Opinions** differ, but on the whole it is probably safer not to use them, as the patient may die during the period of reaction following stimulation.

**Injection of potassium salts into the cisterna magna:**—Experimental work has been carried on in Moscow by Stern (50) by injecting potassium salts into the cisterna magna in order to stimulate the vegetative nervous system by alteration of the calcium/potassium balance. Excellent results are said to have been achieved by Russian surgeons in cases of shock, by cisternal injection of 1 c.c. of a solution of potassium phosphate in a concentration of 1/6 gm. molecule with a PH of 7.6. Further details of clinical trials are necessary before the value of this method of treatment can be completely assessed.

### THE TREATMENT OF THE BURNED AREA.

Many methods of local treatment of major burns have been adopted, but in general they can be described in two main divisions:—

- (i) Those whose action depends on the principle of tanning.
- (ii) Those whose action does not depend on the tanning principle.

**Preliminary treatment:**—Before any method of treating the burned area is applied, all possible measures to prevent or treat shock must be commenced. A thorough surgical cleansing of the whole area is then undertaken, and in most instances this will necessitate a general anaesthetic. The necessity for strict

asepsis must be borne in mind, and caps, masks, gowns and gloves should be worn just as for a major operation.

No antiseptics, aether, spirit, or aether soap should be used, but loose and blistered skin should be cut away, the edges of the burned area carefully excised, and the whole area carefully cleansed, removing gross contamination and dead skin with warm isotonic saline. Where possible any reddened epidemic round the burn should be removed to lessen the likelihood of subsequent blistering. A saline pack is then applied and left in situ for 5 minutes.

**(i) Tanning methods:**—The principle of tanning in the treatment of burns was first introduced by Davidson (51) in 1925, and had as one of its main objects the precipitation of the proteins of the damaged cells, reduction of autolytic changes, and consequently lessened toxin formation and absorption. In practice it was found that tanning also relieved pain, reduced the incidence of bacterial infection, and prevented loss of fluid from the surface of the burned area.

A later development was an attempt to overcome the disadvantages of infection under the tan, tannic acid not being bactericidal. With this object in view Bettaman (52) in 1937 introduced a method using 10 per cent. silver nitrate in addition to 5 per cent. tannic acid and many modifications of the same principle were introduced later, notably by Fantus and Dyniewicz (53) who employed a solution containing salicylic acid as an additional bactericidal agent.

There can be no doubt that the introduction of tannic acid for the treatment of burns was a great advance, and that it resulted in greatly reduced mortality from burn injuries (54). Later work, however, shows that the good results were not entirely the outcome of the main reasons for which the treatment was originally introduced by Davidson, namely the fixation of toxins, but from what were originally regarded as subsidiary factors.

The deterioration which sometimes sets in about 30 hours after injury in patients who appeared to be making good progress and which has been regarded by many as a form of toxæmia arising from destruction of tissue has already been described. In cases where



there is obviously sepsis the syndrome is not difficult to comprehend, but in others, where infection can be excluded with reasonable certainty, the mechanism is difficult to envisage. At the same time the evidence for attribution of the symptoms to some form of toxæmia was supported by the undeniable fact that the post-mortem findings in such cases often showed severe liver necrosis.

In 1938 Wilson et al. (55) pointed out that toxæmia was more common and severe in burns treated with tannic acid than in burns treated by other methods.

More recent work still, has shown that severe centra-lobular necrosis of the liver after burns probably only occurs which tannic acid treatment and results from the absorption of tannates.

Robinson and Graessle (56) say that risks of tannic acid intoxication may arise when there is a large raw surface, or possibly exposed blood vessels, where tanning is used in treatment. They suggest therefore that tannic acid preparations should not be used for burns of this type, although they agree that possibly it still has some place in the treatment of body burns.

Tannic acid as a tanning agent has as a result of this recent work fallen into disfavour during the last two or three years and has been replaced by other tanning preparations which have not its serious drawbacks.

**Aniline dye preparations:**—Aldrich (57) in 1937 advocated the use of a compound of aniline drugs, claiming that infection is the greatest factor in the production of toxæmia, and that the anti-septic action of a combination of acriviolet and brilliant green is advantageous. Other aniline preparations have since been used with good effect and are probably the best method of tanning at present available.

Some surgeons use an aqueous solution of one to two per cent. gentian violet, but a more general favourite is an aqueous solution of triple dye (Gentian violet 1 in 400, brilliant green 1 in 400, flavine 1 in 1,000). Whichever solution is used should be swabbed on or sprayed from a suitable spray and the whole area then completely dried by hot air from an electric hair drier. The air entering the drier should be filtered through wool and the person

operating it should wear a mask. This results very quickly in the formation of a thin supple tan over the burn. No dressing is applied, and the patient is kept in bed under a shock cradle. If properly applied the tan should remain firm and in good condition for about a fortnight. After the original application the chief requirement in treatment is to maintain a careful watch for the onset of sepsis. This is most likely to occur at the edges of the tanned area especially if fresh blisters appear. The tan should be carefully examined at 12 hourly intervals and if there is any appearance of exudate at the edges this must be treated very promptly by applying the tanning solution. Cracks in the original tan may also appear and if they do, they also must be treated with the tanning agent.

Difficulties in nursing are bound to occur in many cases, particularly when both aspects of the trunk are involved. In such cases the patient should lie on the less affected aspect on a sterile towel which has been wrung out of sterile liquid paraffin, which has the effect of lessening friction.

In some cases sepsis may become well established under the tan and in these there is no alternative to removing the whole tan under a general anaesthetic. The whole area may then be treated with saline packs kept constantly moist, or by some other non-tanning method of treatment.

In such cases the introduction of the sulphonamide group of drugs has greatly reduced the danger of severe sepsis. Oral sulphonamide, however, is not necessary as a routine measure and should only be given when sepsis is obviously developing.

If it is indicated the dosage should be adequate, since if an effective dose is brought to bear on haemolytic streptococci and staphylococci during the early phase of rapid increase of the organisms, acute infection will usually be aborted before serious damage has resulted.

The first dose should be from 2 to 4 grammes followed by  $1\frac{1}{2}$  gramme doses four hourly for two days. The dose should then be reduced to one gramme four hourly for another two days after which it should be reduced to one gramme every six hours as the clinical condition improves. In treatment of burns chemotherapy should not be prolonged, but may be

continued for seven days, after which treatment should cease, a second course being given, if required after an interval of one week.

The usual precautions should be adopted, and leucocyte counts carried out to give warning of the possible development of agranulocytosis. In patients treated with sulphapyridine or sulphathiazole the giving of sufficient fluid to ensure a large urinary output so as to minimise the risk of blockage of the urinary passages is most important.

**Other tanning agents. Mercurochrome:—**This was recommended by Turner (58) in 1935 for use as a 2 per cent. aqueous solution. Its main advantage is that it forms a transparent coagulum which enables progress or otherwise to be easily assessed. Later work by Ogilvie, (59) however, showed that it was very deficient in bactericidal power. It has therefore fallen into disrepute.

**Amyl acetate:—**Stewart (60) in 1937 recommended the use of a preparation of amyl acetate for treatment of less severe and extensive burns. Amylacetate is slightly analgesic but has little if any bactericidal action. It was therefore combined with abra-cide, an anti-septic. It was applied on swabs direct to the burned area the swabs being moistened with fresh solution every four days. Its great disadvantage is its penetrating odour and this has prevented its wider adoption.

The aim in local treatment of first degree burns is to maintain a dry impermeable tan until epithelialization is complete or nearly so. In second degree burns the object is to prevent bacterial invasion and obtain a healthy granulating surface as early as possible to permit of early skin grafting.

These objects are usually attainable but in certain burns where deeper structures have been involved there is often already a coagulum of charred tissue and local thrombosis of blood and lymph vessels. There is therefore little loss of fluid from the burned surface, but a great tendency to oedema. The type of coagulum present in this type of case will not prevent sepsis no matter how careful the original surgical toilet of the wound.

Tanning methods are therefore of little use, and this type of burn must be treated by some non-tanning method (61).

## (ii) Methods of treatment not depending on tanning.

**Saline baths:—**The treatment of burned patients in baths containing fluids is one of the oldest therapeutic measures known to medicine, and from about 1930 onwards has been resuscitated as a means of treatment by many surgeons, the rationale as against coagulation methods being that a coagulum is liable to inhibit the process of sloughing and therefore hinder natural repair. Plain water, physiological saline, mild anti-septics and hypertonic salt solution have all been used (62).

Following the strong criticism advanced against tannic acid treatment, non-tanning methods received an additional fillip and treatment by saline baths has recently become very widely used for war casualties, notably in the R.A.F.

The treatment, in brief, consists of immersion of the patient in a saline bath which is kept at a constant temperature. The bath must be sterilizable, and a constant stream of sterile saline, maintained at correct concentration, and at a temperature of 100 degrees Fahr. is run in. The sterility of the saline used is ensured by bi-weekly bacteriological examinations, and the bath itself should be sterilized after use by scrubbing with soap and mopping with pure lysol, after which it should be swilled with the sterile saline.

Treatment by saline bath should not be commenced until shock is under control, and until this stage is reached the burn should be treated by dusting with sulphanilamide powder and applying tulle gras dressings.

When the bath treatment is commenced outer dressings should be removed, leaving the tulle gras dressing in situ, and the patient lifted bodily into the bath by specially trained nurses or orderlies. Care must be taken to cause the patient as little pain as possible and all nursing personnel should maintain complete aseptic technique. The patient should be encouraged to move his limbs as freely as possible whilst in the bath, which will help in washing off the dressings. Even adherent dressings come off in due course in this way and the lack of pain is a very important factor in maintaining the patients well-being.

As soon as the dressings have become detached the burned surface should be cleaned

very gently and carefully with swabs of cotton wool. In this way all secretion can be removed, and dead tissue and epithelial and sebaceous debris from the edges of the burn detached. The average time for all this to be done, and during which the patient will remain in the bath, is up to three-quarters of an hour.

Whilst the patient is in the bath the sheets on his bed should be replaced with sterile ones, and after bathing he should be returned to bed and the unburned portion of his body quickly and carefully dried with warm towels. The burned area should be insufflated with sulpho-namide powder before it becomes quite dry and then covered with a single layer of tulle gras. Over this are placed light packs of saline soaked gauze. It is very important that the patient should not be allowed to become chilled during this procedure, and this may be prevented by the use of a suitable electric radiator.

The baths are best given in the morning, and during the day the dressings should be kept moist with saline to prevent them from sticking. In order to be quite certain that the dressings never become dry it is wise to remove them twice in 24 hours, leaving the tulle gras in position, and replace them with fresh dressings.

The burn, if this procedure is accurately followed, is never fully exposed except in the bath. Baths should be repeated daily although in very septic cases it may be advisable to give them twice daily.

It is said that under this regime, sepsis is quickly brought under control, (63) and that the time taken to heal first degree and less serious second degree burns is less than half that taken by any other method whilst in second degree burns involving deeper structures many months may be saved in treatment.

One great advantage is that very early movement of the part is permitted, and there is therefore no danger of prolonged immobilization leading to impairment of function.

There are certain contra-indications. The successful employment of this method necessitates a patient who is co-operative. With young children as a result of fear, it may be impossible to persuade them to remain in the

bath, and forcible methods are, of course, in the circumstances impossible.

The method is not suitable for cases with badly exposed tendons and open joints.

If associated injuries such as fractures are present, placing of the patient in the bath may not be possible.

Although certain surgeons object to the method on the ground that control of infection is lacking, and that there is no control of fluid loss, there seems to be little doubt that in practice it is most satisfactory once the dangerous period of shock has been safely weathered.

Probably the most serious practical objection is that a good deal of rather expensive apparatus is necessary if the method is to be carried out efficiently for a large number of cases. This is a serious drawback in war time in operational areas and in cities liable to air attack, but in surgery in peace time is not so important. There is therefore probably a great field for this therapeutic measure in industrial traumatic surgery after hostilities have ceased.

**The Buryan-Stannard bag (64):**—In this method of treatment the whole of the area is enclosed in a silk envelope, which is sealed off in such a way that cross infection is impossible. The envelopes are made of fine pure silk cloth coated with synthetic resins which are not affected by hypo-chlorites or by boiling. Suitable shapes have been designed to fit any part of the body.

Different concentrations of a stock solution of one per cent. electrolytic sodium hypochlorite containing 16.5 per cent. by weight are employed as an irrigating medium, according to the situation and severity of the lesion.

Surgical removal of burned tissue is first carried out as in other methods of treatment; after which the solution is kept flowing over the lesion and surrounding parts until the envelope is applied. The burn is then irrigated with the solution three times a day for periods of twenty minutes until healing is well advanced, the envelope being left undisturbed in the meantime. The envelope is transparent so that the progress of healing can be observed throughout.

The process sounds rather complicated, but in practice is not so, since changing of the

envelopes is not necessary, and the technique of irrigation is simple.

It is claimed that in this method of treatment fluid loss is stopped almost immediately and in most cases pain is quickly relieved. Movement of the affected part can be started very early and this is of special value in cases of burns of the hands. Toxaemia is unusual as the products of tissue break-down are carried away as soon as they form. In burns covering a large area, a healthy base for skin grafting is quickly available.

**Sulphonamides and penicillin:**—The discovery and introduction of the sulphonamide group of drugs, and later of penicillin, has resulted in a great advance in the treatment of burns, with consequent reduction in mortality, although full appreciation of the place of penicillin in such treatment is not yet possible, as the drug has not yet been manufactured in sufficient quantities to permit of general release, and trial on an extensive scale. The internal administration of sulphonamides as part of the treatment of infected burns has already been described, and its use in certain circumstances as a local application has also been indicated, although its employment as a sole method of treatment remains to be dealt with.

As a local application it is probable that the greatest value of these drugs is in cases where sepsis threatens to supervene, but many workers have used preparations of sulphonamides from the beginning of treatment, basing their rationale on the well-known fact that burns are probably more prone to infection with haemolytic streptococci than almost any other form of injury.

A method of treatment of burns employing micro-crystalline sulphathiazole has been employed with apparent success. In this method the burn is cleaned in the usual way after which it is insufflated with powdered micro-crystalline sulphathiazole until the area is thinly dusted with the powder. The whole is then covered with sterile gauze and tightly bandaged to prevent oedema and loss of plasma into the surrounding tissues. The burn is dressed in this way every third day.

Burns involving total skin loss are skin grafted as soon as a healthy granulating surface is formed, and it is said that the application

of the sulphathiazole does not interfere with the viability of the grafts.

Wallace (65) has used a paste consisting of 30 per cent. albucid soluble (which is a soluble sulphonamide) and 10 per cent. of cod liver oil with equal parts of kaolin, and has found it to be particularly efficacious in burns of the face.

In some cases, especially in burns of the hand, sulphonamide powder has been used as a dressing, covered with tulle gras, and the whole encased in a light plaster cast. The plaster is applied so that the wrist is immobilized, but the fingers are free inside the cast. The patient must be instructed to move his fingers frequently.

Evans and Hoover (66) have treated burns with a cream of sterile sulphonamide powder mixed with lanolin and cold water so that the final concentration of sulphonamide is 6 per cent. by weight. There was an occasional sulphonamide rash, but no other systemic reaction attributable to the drug.

Clebrook and other workers (67) at the Glasgow Royal Infirmary have obtained good results as a first aid measure from a cream containing 10 per cent. sulphonamide and 1 per cent. cetyltrimethylammonium bromide, which is designed both to prevent multiplication of bacteria on the burned surface, and also to be easily removable if other treatment should be found necessary.

In cases necessitating more complete treatment the same workers have used a water soluble cream containing sulphanilamide and glycerine prepared according to the following formula.

Sulphanilamide	... 10 gm.
Glycerine	... 10 gm.
Oil Ricini	... 25 gm.
Janette wax SX	.. 10 gm.
Water	... 45 gm.

All blisters are first cut away, and a surgical toilet carried out in the usual manner. The burned area is then cleansed with cetyl-trimethyl-ammonium bromide solution. The cream is then applied direct with a spatula, or on gauze or other suitable form of dressing, covered with wool, and firmly bandaged.

The dressing is left undisturbed for from 6 to 10 days after which it is removed and a

similar fresh dressing applied if found to be necessary.

It has been found that absorption of sulphanilamide is usually not great. In most patients a blood concentration of from 1 to 6 mgm. per 100 c.c. is reached during the first three or four days.

In some cases of very deep or extensive burns higher concentrations were reached and in such cases it is suggested that the strength of the cream be reduced to 3 per cent., or that the sulphanilamide should be replaced by sulphathiazole which is less soluble and therefore more slowly absorbed.

Insufflation with a Stanford Cade's sulphonamide insufflator is probably the best method of application of sulphonamide powder but one difficulty is that the powder is hygroscopic and therefore tends to clog. Some workers have found it simpler and more satisfactory on the whole to apply the powder from a sterile swab.

Certain precautions are necessary in its use, of which perhaps the most important is that it should be sterilized before application.

Attention was first drawn to the necessity for this in 1942 when a fatal case of tetanus was reported (68) and it was concluded after investigation that the infection with tetanus spores could only have occurred through contamination of the sulphanilamide used. The possibility was confirmed experimentally by Welch et al (69) who showed that if sulphanilamide powder containing tetanus spores is implanted into the tissues of animals, the presence of the drug does not prevent the onset of tetanus.

Sulphanilamide should therefore be sterilized before use by one of the methods recommended by the Medical Research Council (70), and the resulting product discarded if it becomes discoloured.

The danger of absorption of toxic quantities of sulphonamides should also be kept in constant mind even in local treatment. Blood concentrations exceeding 50 mgm. per 100 cc. have been recorded after insufflation of extensive burns with sulphonamide powder on three successive days. Estimates of the sulphonamide content of the blood should be carried out by Fuller's method (71), which only requir-

ed a few drops of blood, and is sufficiently accurate for clinical purposes. Blood concentration should never be allowed to exceed 10 mgm. per 100 cc. in the case of sulphanilamide or sulphapyridine and 7 mgm. per 100 cc. in the case of sulphathiazole.

Sulphathiazole is the drug of choice for local application as it is absorbed very much more slowly than the other members of the sulphonamide group. (72).

**Penicillin:**—Penicillin probably marks the greatest single advance in the treatment of septic conditions since the original discovery of the principle of antiseptics. Difficulties in its supply have hitherto prevented its trial on an extended scale except in military formations. Literature describing its use in cases in which it has been employed by the military authorities has as yet been published in comparatively few cases. Enough has been revealed, however, to show that the vistas opened up by its use are well nigh limitless.

The accidental inoculation of a culture plate with the mould of *penicillium notatum* some years ago caused inhibition of the growth of staphylococci near it, and this was noticed by Alexander Fleming. (73) Fluid cultures of this mould showed that it contained a substance, penicillin, which inhibited the growth of many gram positive bacteria.

More recently Florey and others (74) have purified penicillin and showed that it will inhibit the growth of staphylococcus aureus and streptococcus pyogenes in a dilution of 1 in 1 million even in the presence of pus. It is therefore many times more powerful than the most potent of the sulphonamide compounds. It has been used intravenously without toxic effects and is excreted in the urine from which it can be extracted.

A practical method of application of penicillin has been described by Clark et al (75). Penicillin was made into a soft yellow cream by adding it to a molten mixture of lanette wax SX and castor oil, and used in the treatment of a series of 42 cases of burns.

It was found that this cream retained its activity for 15 days at ordinary room temperature in the United Kingdom, and for over 4 weeks at a temperature of 2 degrees Cent.

The minimum application for elimination of haemolytic streptococci appeared to be about four applications of the cream, containing about 100 to 150 Oxford Units per gramme. Staphylococcus infection was also improved, but appeared to require a higher concentration of penicillin. Coliform bacilli, *B. Proteus*, and *Pyocyaneus* did not usually disappear.

Further work with penicillin is undoubtedly being carried on on an extensive scale and the results will be awaited with eagerness throughout the civilized world.

### BURNS OF SPECIAL AREAS.

**Burns of the hands and fingers:**—The general principles which have already been enunciated apply with equal force to burns of the hands, but in addition there are some special features of these burns which call for special comment. Firstly it is most important that the problem of preservation of function be kept constantly in mind, and it should also be remembered that the problem is made more difficult by reason of the fact that the hand probably harbours more organisms than any other part of the body. These two factors are largely inter-dependent since sepsis is the cause of severe scarring which in its turn is likely to interfere with the very complicated mechanism of full function of the hand and fingers. It is therefore vital that any early form of dressing used should be antiseptic in nature, and in practice it has been found that gentian violet, or triple dye jelly, are most suitable since they have the additional advantage that the thin supple tan they produce has no tendency to contract.

Up to comparatively recently tannic acid was almost the universal form of treatment for burns of the hand, but in addition to the general drawbacks to its use which have already been described, the coagulum is apt to contract and interfere with the vascular supply to the fingers, giving rise to disastrous results which may even go so far as to cause ischaemia and necrosis of the terminal phalanges.

There are certain other points which should be kept in mind. Blisters should be opened with strict aseptic precautions, but the epithelium left *in situ*. The coagulating medium applied should be applied only to the burned area and the margins of the burns covered by a very narrow strip of coagulum. If large

areas of unaffected skin are covered slight contraction of the healthy skin is caused and is apt, in combination with the tan on the burned area, to cause interference with the blood supply, a complication which must be avoided at all costs. The earliest sign of interference with the blood flow in the digital arteries is pain in the finger tips and this should always be enquired about in cases of burns of the hands and fingers. If this symptom occurs the tan should be split and the arm kept well elevated.

The treatment of burns by the envelope method and by the application of sulphonamide and plaster has already been described. In the former method there is little danger of deformity being caused by fixation of the hand in bad position, but in tanning methods and in the plaster method this is a danger which is ever present.

Care should therefore always be taken to ensure that the fingers are well separated between pads, and the hand placed in the position of function, with the wrist at 60 degrees of dorsiflexion, all the finger joints at 50 degrees of flexion, the thumb being separated from the palm in abduction and opposition, and the second phalanx of the thumb in slight flexion.

In deep burns of the hands, as soon as any dead tissue has sloughed and healthy granulations are present, skin grafting should be carried out without delay.

Loss of skin itself may lead to severe distortion, and in these cases any skin contraction should be released early, when in the case of younger people intra-articular changes may be prevented, although in older persons the outlook is not nearly so good.

**Burns of the face:**—Burns of the face also present certain special problems. The necessity of adopting methods of treatment which will obviate unsightly scarring are obvious. Apart from this the face is very vascular, and this is liable to lead to excessive fluid loss in the early stages, and a degree of toxæmia disproportionate to the size of the burn in later stages.

The line of treatment depends to a certain extent on what facilities are available for treatment during the first day or two after injury. Where these are limited it is probable that the application of gentian violet or triple

dye jelly is on the whole most likely to prove satisfactory. If hospital treatment is possible within a few hours, saline masks are probably the best form of treatment. The burned area should be carefully cleansed under a general anaesthetic, after which a gamgee mask is made to fit the face, with openings for the nose and mouth. The burned area is dusted with sulphonamide powder and covered with tulle gras after which the mask is applied and kept continually moist with a saline drip.

Tannic acid should never be used in casualties suffering from burns of the face.

In burns involving total skin loss early skin grafting is essential if scarring is to be prevented, and this should be done as soon as a healthy granulating surface is present.

In many cases of burns of the face the eyes will be affected, and in all cases of burns of the face attention must be paid to the eyes, even if they have not obviously been involved. They should be bathed if necessary with boric acid lotion and instilled with argyrol. If the lids tend to stick they should be smeared with a little Ungt. Hyd. Ox. Flav. or cod liver oil.

In the early stages, when the eye has been affected the cornea may appear perfectly clear and at this stage it is most difficult accurately to estimate the actual extent of the injury. In severe cases the cornea quickly becomes dull and opaque and an eschar may form. This is followed by granulation and frequently ulceration of the cornea. Adhesion of the lid to the surface of the eye is a real danger and every precaution must be adopted to prevent this occurring.

### Skin grafting of burn injuries.

One of the main objects in the treatment of burns is to obtain sound healing with the least possible delay and to avoid unsightly scarring and disabling contractures if at all possible.

The judicious use of skin grafting is one of the most satisfactory methods of attaining these objects.

Natural epithelialization in burns is variable in rate, but is always relatively slow. Moreover, newly formed epithelium covering burns is often functionally unsatisfactory. It is stretched and shiny with numerous blood vessels which are visible to the naked eye,

devoid of hair, and with no sebaceous glands. The surface breaks down very easily following the slightest trauma, or even with variation in tension following normal movement.

The reason for this is that underneath the newly formed epithelium is fibrous tissue very deficient in vascularity, instead of true derma which would support and attach it to the subcutaneous tissues.

To prevent this unsatisfactory epithelialization the logical procedure is to cover raw areas with whole skin as soon as possible. This of course necessitates the presence of a healthy granulating surface with a spontaneous healing tendency. The methods of attaining this have already been described.

The surface should be smooth, pink in colour, level with the surrounding surface or even slightly depressed, and painless to touch. The edges should show epithelial response in the shape of a bluish white margin of epithelium attaching itself firmly to the granulations. An infected surface, with painful, soft, greyish granulations, perhaps exuding a little pus, is not in a suitable stage for skin grafting. If the surface is in this stage it must be conditioned before grafts can be applied and this is best done by application of saline dressings every two or three hours, alternating with eusol packs. Firm pressure is useful in keeping down granulations, and may be maintained by the application of crepe bandages. The dressings may be kept moist by covering them with jaconet or oiled silk. As the condition of the surface improves, the eusol may be discontinued and saline packs alone applied. Under this regime rapid improvement is usual and an indication that the infection has been controlled is the disappearance of pain and absence of tenderness of the surface to the touch. In some cases the use of sulphonamide or penicillin may be necessary to bring sepsis under control.

As soon as it is certain that the surface is perfectly healthy, grafts may be employed.

The most generally used free grafts are:—

- (i) Small deep grafts (Staige-Davis)
- (ii) Thick razor grafts (intermediate or split skin grafts).

Staige-Davis grafts are not completely satisfactory in areas not covered by clothing, as

they result in a spotty appearance. Their greatest use is in hastening healing in areas which are difficult to condition properly, as they frequently 'take' when other methods of grafting fail. The method consists in principle of removing small pinches of skin under local anaesthesia and applying them direct to the clean granulations. The method is obviously rather slow, and has the added disadvantage that slow epithelialization favours the development of scar tissue. Pinch grafts, therefore, although they have their place in the treatment of burns, especially for extensive skin loss on the trunk, or legs, where large razor grafts from other sites cannot be obtained without difficulty, are by no means the method of choice.

The technique consists of removing small cones containing all the layers of the skin by lifting a small pinch of skin with a straight needle, and severing its base with a sharp scalpel. The cone of skin thus removed is applied directly to the granulations, which have been previously prepared with saline, but not scraped, so that its epithelial edges are spread flat on the surface. Further grafts are then applied in rows one cm. apart. The whole is then covered with tulle gras and afterwards with two layers of gauze wrung out of paraffin and flavine. Pressure is applied by means of a bandage tightly applied. The dressing is ordinarily left undisturbed for about a week. If any sepsis is apparent saline dressings should then be continued, but if not, tulle gras dressings should be applied.

**Razor grafts:**—Razor grafts consisting of epidermis, dermis, and small amounts of corium are probably most useful of all, since they are applicable for delayed covering or granulating surfaces, or for the relief of late contractures. Areas up to 180 square inches or more have been successfully covered at one time by grafts of this type.

The technique of razor grafting is a highly specialized art only to be learned by practice and experience. No attempt will, therefore, be made to describe the procedure in any great detail, but the general principles involved will be briefly indicated.

Most surgeons of experience take their grafts by means of a razor sharp knife with a "biting" edge, the only other equipment re-

quired being a board or Blair sucker to flatten the skin in front of the knife. The graft should be taken with sawing action as thickly as possible without involving the subcutaneous fat. Grafts can be taken from the inner or outer side of the leg, or from the inner surface of the arm. The thickness of the graft being taken can be estimated by the colour of the cutting edge of the knife as seen through the skin. When the graft is getting too thin the edge can be plainly seen and appears bluish grey in colour. At the best thickness the colour is yellowish white. If the graft is too thick it appears opaque and the edge of the knife cannot be seen. At this stage it is probable that subcutaneous tissue is being included in the graft.

Less experienced surgeons may use a Humby knife, which has adjustable guard which prevents the taking of too thick a graft.

A more elaborate instrument is the Padgett dermatome.

The graft having been taken it must be applied to the raw surface under treatment.

The granulating surface having been washed with normal saline, and the surrounding skin prepared with aether and spirit, the granulations should be scraped away until the deep fibrous layer is reached, or excised down to healthy tissue. Bleeding must be controlled by pressure, hot packs, or applications of 1 in 1,000 adrenalin.

The grafts should then be laid with the raw surface outwards on tulle gras dressings, after which the tulle gras should be applied to the raw surface and fixed with a few sutures round the edges.

The dressings should be removed at the end of a week. If the graft has been successful it should be covered with a saline dressing for a few hours and then protected with a tulle gras dressing for a few days.

If the graft has not been successful, the wound will at some stage discharge and emit a foul odour. If this occurs the whole dressing must be removed and saline and eusol packs applied.

If there are small areas still uncovered in an otherwise successful graft, saline and eusol packs may be applied, or gentian violet or triple dye painted on to the raw areas.



Finally it may be stressed that to allow an extensive raw surface to heal by natural processes and formation of scar tissue is a procedure which in these days can in no way be justified.

### NUTRITION IN BURN CASUALTIES.

Burn casualties are liable to develop certain metabolic conditions which demand some consideration from the point of view of diet and general management, and attention to these details is likely to promote early convalescence and improved end results.

In infected cases with fever, for example, there is increase in body metabolism. In addition there is likely to be a heavy loss of protein in exudates. Secondary anaemia is a frequent complication of burns as of other debilitating conditions, and must be treated if occasion arises.

Wallace (76) has shown that where a granulating area is in existence for a long period there is a heavy loss of body chloride. Besides these the possibility of acidosis and liver damage must be borne in mind. It is estimated that two-thirds of the body's sulphur is contained in the skin, and in cases where there has been extensive skin loss the replacement of the lost sulphur becomes a matter of some consequence.

With the increase in the metabolic rate increase of all three food principles is necessary. Taylor (77) has shown that in severely burned patients the excretion of nitrogen is excessive and there is a large increase of residual nitrogen in the urine. It is therefore fundamental to advocate a high protein diet in all severe cases of burns in order to replace this excessive loss of nitrogen.

Both the nitrogen loss and the sulphur loss can be well treated by a diet with plenty of eggs, the theory that such a diet precludes the use of sulphonamide drugs being now exploded.

In suitable cases a high salt diet will prove a stimulant to healing in patients with a large granulating area from which there has been continual loss of chloride.

Iron in the form of ferrous salts, or scale preparations may be used if anaemia is among the symptoms.

Dehydration is a very real problem in burn cases, and must be guarded against, particularly in hot climates where fluid loss through

the skin is likely to be great. The disturbance of renal function following burns has already been described, but within 48 hours after the receipt of injury renal function is as a rule restored, and fluid intake in adults should be at least 5 pints in 24 hours. The volume of urine in adults should be maintained at at least 1,000 c.c. daily. If 1,000 c.c. to 1,500 c.c. are allowed for vaporisation from the skin and lungs, and 200 c.c. for water contained in the stools, the total fluid loss is 2,200 c.c. to 2,700 c.c. and this must be adequately replaced if the patient is to make satisfactory progress.

In the early stages the administration of glucose is beneficial especially if there is a tendency to acidosis and possible hepatic damage, since, following absorption, glucose helps to protect the liver cells from circulating toxins.

Up to 10 ounces of glucose may be given in 24 hours and it is often helpful to give it together with orange or lemon or lime juice, since this also increases the vitamin intake.

### CONCLUSION.

The primary object in treatment of injuries caused by burns, as in treatment of all other forms of injury, is to save life.

The biggest single factor in the causation of deaths from burns is oligæmic shock. The advances which have been made of recent years in the treatment of this condition have been so great, that even extreme cases are capable of resuscitation, provided the necessary highly trained personnel and other treatment facilities are available. At present this includes ample supplies of blood plasma which can only be obtained if healthy individuals are prepared to donate their own blood for the relief of the sick and injured.

It may be that at some future date an effective substitute for human blood plasma will be perfected, or shock will be amenable to treatment by some other means, but that date is not yet, and in the meantime the organization of an efficient blood bank in every large centre of population is an essential feature of the treatment facilities for all forms of traumatic surgery. Given ample supplies of plasma, and the equipment and staff for its proper administration, the problem of treatment of oligæmic shock can be reduced to relatively small proportions.

Further important objects in the treatment of burns are to reduce to a minimum the period of incapacity, and to maintain function by the prevention of deformities. The introduction of the "tanning" method of treating burns; the use of saline baths, and envelope treatment; the discovery of the value of the sulpho-namide group of drugs and penicillin in preventing sepsis; and the immense strides which have been made of recent years in the technique of skin grafting, have all contributed in very large measure to the attainment of these objects.

Whatever may be the horrors of war, there can be no doubt that during wars at least one good result emerges, namely advancement of medical and surgical knowledge.

Scientific medical effort has up to now been too much occupied with the practical problems of the emergency to devote much time to statistics and analytical records; but when these are finally available, there can be little doubt that they will reveal that the advances in medical and surgical science which have been made, have been greater by far than corresponding advances made at any comparable period during human history.

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## APPENDIX

### CASE RECORDS

The following extracts are taken from case records of 270 burn casualties treated by the author following air raids on two large industrial cities in the North of England in December, 1940.

The extracts have been chosen as representative illustrations of some of the methods of treatment which have been described in the preceding pages.

Most of the cases were originally received in a combined hospital and first-aid post operating in the middle of a heavily bombed target area.

Of the 270 burn cases seen, 57 were discharged to the care of their own doctors immediately after receiving first aid treatment. 128 were detained for periods up to 48 hours, after which they were treated as out-patients or discharged to the care of their own doctors.

More serious cases were, whenever their condition allowed, transferred to a base hospital outside the target area within a period of 48 hours. 53 such cases were so transferred, the remaining 32 being either dead, or too ill to stand removal.

The total mortality was 19, which included 7 cases who were moribund on admission. The remaining 12 cases were all comparable to cases Nos. 39 and 95 quoted below having suffered very severe burns, in several instances complicated with other serious injuries.

**Case No. 4:—**Hannah F..... aged 37 years, rubber worker. Second degree burns of palmar surfaces of both hands and forearms following attempts to extinguish a thermite bomb with

a bucket of water. First seen half an hour after receipt of the injury. General condition good, blood pressure 85/130 mm.  $\frac{1}{4}$  morphia injected intra-muscularly, and one pint of warm sweet tea by the mouth. Two hours later general condition remained good. Surgical toilet under gas and oxygen anaesthesia and burned area treated with triple dye. Transferred to base hospital after 24 hours. Finally discharged on 24th day. Burns healed with full function. General condition good.

Case No. 17:—James R. . . . aged 42, A.R.P. rescue worker. Severe burns of the palmar surfaces of both hands due to grasping a burning rafter whilst releasing a trapped casualty. First seen one hour after receipt of injury. General condition good. Given gr.  $\frac{1}{2}$  morphia intra-muscularly and one pint of hot sweet tea. After 2 hours general condition still good. Pulse 90. Systolic Blood Pressure 135 mm. Injury cleaned up under gas and oxygen anaesthesia and dusted with sulphanilamide powder. Sterile dressing applied. Transferred after 6 hours to base hospital where the burn was treated by Bunyan Stannard bag method. Discharged on 37th day after injury. Wound completely healed and functional result excellent.

Case No. 39:—William . . . aged 37, Auxiliary Fireman. Severe second degree burns both legs and both aspects of trunk due to being trapped in a burning building. First seen 2 hours after injury. Condition on admission desperate. Pulse uncountable and almost imperceptible at the wrist. Given 1000 cc. filtered plasma rapidly. Very slight temporary improvement. Plasma continued as slow drip. Oxygen administered by B.L.B. mask. Condition steadily deteriorated and patient died 5 hours after admission.

Case No. 54:—Ethel M. . . . aged 28 years, Laundress. Multiple small but deep burns of arms and lower parts of both legs due to splashing with drops of burning oil from an oil bomb which fell some distance away from where she was standing. First seen one hour after injury. General condition good. No obvious signs of shock. Pulse 100, systolic blood pressure 125 mm. Given gr.  $\frac{1}{4}$  morphia intra-muscularly and one pint of hot sweet tea. After a period of rest of 4 hours the burned areas were carefully cleaned up without anaesthesia and treated with triple dye. Discharged to

care of her own doctor after 18 hours, her general condition being excellent.

Case No. 73:—James F. . . . aged 46, Fireman. Scorching of face following opening the door of a room which was on fire. First seen 3 hours after injury. General condition good, but patient, who had been on continuous duty for 36 hours was exhausted. Given gr. 20 Chloral Hydrate and grs. 30 Potass. Bromide and put to bed. Face treated with Cod Liver oil mask. Patient detained 36 hours for observation after which discharged to return to duty.

Case No. 81:—Joyce R. . . . aged 23, rubber worker. Second degree burns of front of chest due to clothing igniting following explosion of thermite bomb in her home. The clothing was rapidly removed by her sister which no doubt prevented more serious injury and probably saved her life. First seen three-quarters of an hour after injury. General condition then quite good. Pulse rate 100. Systolic Blood pressure 130 mm. Given gr.  $\frac{1}{4}$  morphia and one pint of hot sweet tea and placed in observation ward. One hour later her condition was obviously deteriorating. Pulse rate had risen to 135 and Systolic Blood Pressure fallen to 95 mm. She was therefore given 500 cc. filtered plasma which restored the blood pressure to its former level. The burns were then cleaned under gas and oxygen and treated with triple dye. Progress was maintained and she was sent to base hospital after 48 hours. Finally discharged after a further period of 32 days. Condition on discharge good.

Case No. 84:—Charles G. . . . aged 51, First-aid party worker. Second degree burns dorsum of right foot and half way up right leg, due to foot and leg passing through a burning floor board. First seen one and a half hours after injury. General condition not good. Skin pale, Pulse 107, Systolic Blood Pressure 95 mm. Anxious and restless. Given gr.  $\frac{1}{4}$  morphia intra-muscularly and one pint of hot sweet tea. 500 cc. filtered plasma given in about 20 minutes. Condition much improved. Systolic Blood Pressure now 115 mm. Surgical toilet under open ether and burned area treated with triple dye. Additional 500 cc. filtered plasma given by drip on termination of above treatment. Transferred to base hospital after 48 hours. Discharged to his home on 37th day. Burned area healed and general condition good.

Case No. 95:—Mary McM. . . , aged 74. Severe second degree burns of leg and trunk result of clothing becoming ignited when her home was hit by several incendiary bombs. First seen one and a quarter hours after injury. Pulse almost imperceptible at the wrist and uncountable. Sighing respirations. Not conscious of pain. Quite clear mentally, 1,000 cc. of filtered plasma transfused into median cephalic vein in about half an hour. Pulse a little better. Systolic Blood Pressure 80 mm. No attempt was made to deal with the injury. Plasma continued by drip but condition of patient steadily declined and she died 6 hours after admission.

Case No. 119:—Ethel M. . . , aged 18. Rubber worker. First degree burn right forearm with some blisters and one small area second degree. First seen 8 hours after injury. Burn cleaned without anaesthetic and treated with paraffin wax. Attended as out-patient for 16 days by which time the burned area had completely healed. Instructed to report after one month for observation, which she did. No visible scarring.

Case No. 137:—Roger J. . . , aged 37, Tram driver. Severe burns of left foot and ankle. Deep charring of muscle tissue and possibly of bone. The ankle had been trapped under some burning furniture. Also crush injury of right leg and incised wounds head and shoulders which had apparently bled freely. General condition very poor. Extreme pallor, pulse feeble, 140 per minute. Systolic Blood Pressure 70 mm. Given gr.  $\frac{1}{2}$  morphia intra-muscularly and hot sweet tea followed immediately by 1,000 cc. whole blood rapidly administered. Condition improved. Pulse 120. Systolic Blood Pressure 105 mm. At this stage it was decided to amputate the injured part, and this was done under gas and oxygen at the site of election below the knee. The wounds of the head and shoulders were dealt with at the same time. Plasma was continued throughout the operation as a slow drip. Condition after operation fairly satisfactory. Returned to bed with shock cradle and filtered plasma continued as slow drip. In spite of the severe nature of his injuries and his bad condition on admission he made steady progress and was transferred to base hospital on the 8th day after operation. Finally discharged from base hospital after a further period of 37 days general condition being good.

Case No. 164:—Jean F. . . , aged 17. Rubber worker. Small areas first degree burns face with about 8 small blisters. Isolated small burns chest due to being trapped for a short time in a burning building and hit by flying sparks. General condition good. Given gr.  $\frac{1}{2}$  morphine and one pint of hot sweet tea. After 3 hours' rest burns on face treated with paraffin wax. Burred patches on chest treated with gentian violet jelly. Discharged to care of own doctor after 36 hours.

Case No. 229:—Walter B. . . , aged 5 years. First degree burn both buttocks. Reddening of skin with one or two small blisters. First seen 3 hours after injury. General condition good but very frightened. Given 10 gr. Potass. Brom. by mouth and hot drinks of giaxo sweetened with glucose. Blisters aspirated and cod liver oil dressing applied to burned area. Discharged to care of own doctor after 24 hours.

Case No. 253:—John W. . . , Insurance agent. Extensive second degree burn of posterior aspect of thorax due to falling among some burning debris. Whole burned area filthy with dust and debris. First seen half an hour after injury. General condition then fair. Given gr.  $\frac{1}{2}$  morphia and one pint of hot sweet tea. Pulse 130. Systolic Blood Pressure 90 mm. Given 1,000 cc. of filtered plasma after which Blood Pressure arose to 120 mm. Burned area thoroughly cleansed under open aether. Plasma continued by drip. Condition after operation good. Systolic Blood Pressure 120 mm.

In view of the extremely dirty condition of the wound it was dusted with sulphanilamide powder and treated with saline packs. On the second day saline packs alternating with eusol packs were substituted. General condition remained fairly good. On the fifth day after injury deterioration set in and signs of broncho-pneumonia appeared in the chest. This was treated with sulphapyridine and subsided. After a further period of 14 days a clean granulating area about 8 inches by 6 inches was available and this was treated with thick skin grafts taken from the leg. He was finally discharged in good condition 51 days after the original injury.

Case No. 267:—Elizabeth S. . . , aged 32 Machinist. Second degree burns palmar surface right hand. First seen one hour after

injury. General condition good. Pulse 100. Systolic Blood Pressure 125 mm. Given gr.  $\frac{1}{4}$  morphia intra-muscularly and one pint of hot sweet tea. Allowed to rest. After 2 hours condition still good. Burned area cleansed under

gas and oxygen and triple dye applied. Discharged to her home after 48 hours and told to attend for dressing. Discharged healed on 29th day after injury. Functional result excellent.

## INFECTIONS OF THE FOOT

### CLINICAL ASPECT

*(Continued from previous issue)*

The following is a working classification that has been adopted for studying the infections of the foot:—

- I. Whitlows—infected conditions of the same type as are observed in the hand. Superficial in one of the layers of the skin, the nail being considered as part of the epithelium.
  - (a) Phlyctenoid or subcuticular whitlow.
  - (b) Periungual whitlow or paronychia.
  - (c) Sub ungual—Onychia.
- II. Acute spreading infections.
- III. Deep infections.
  - (a) Whitlow of the pulp.
  - (b) Cellulitis.
  - (c) Gangrene.
- IV. (a) Abscesses of the foot—
  - (1) With reference to foot spaces;
  - (2) Special types of abscesses—abscess heel, collar-stud abscess, etc.
  - (b) Osteomyelitis.
- V. Synovial infections—
  - (a) Acute; and
  - (b) Chronic.
- VI. Lymphatic infections.

- VII. (a) Ulcers—tropical ulcers, Naga sores. chronic ulcers.
- (b) Fungus infections.
- (c) Mycetoma Maduræ.
- (d) Corns and callosities.
- (e) Infected bursa.
- (f) Ingrowing toe nail.
- (g) Arthritis.
- (h) Ainhum.

### I. SUPERFICIAL WHITLOWS.

Infections that occur in different layers of the skin including those which affect the nail bed, because the nail is modified epidermis, are dealt with in this group.

(a) Phlyctenoid or subcuticular whitlows:—Most of the subcuticular whitlows develop as shoe bites. The usual situation is over the dorsal aspect of the toes, the posterior aspect of the heel and the inner part of the foot. They are the result of friction between the newly worn shoe or the straps of the chappal and the skin. When the leather used is rough or if socks are not worn there is much friction between the foot and its wear which results in these shoe bites. They start as blisters where-in there is collection of serum which raises the epidermis from the dermis. These may get infected secondarily and form a pustule. If the shoe or sandal is discarded as soon as a blister develops the process may subside with

it; otherwise, the blister may burst and get secondarily infected. These subcuticular whitlows start also after injury in the toes, more frequently in the great toe. In these cases the progress is the same as before but there is the danger of spread of infection to the superficial or sub-cutaneous cellular spaces leading to cellulitis and in some debilitated individuals to gangrene.

Treatment consists of early snipping of the blister and dressing with streptocide or 1% aqueous solution of gentian violet. The wound heals in 7 to 10 days.

Paronychia of the toes has the same clinical features as that of the fingers described by Kanavel. To start with, there is a small bead or two of pus collected in the subcuticular tissue on one side of the nail. When neglected it spreads along the side of the nail and back to the base becoming secondarily a typical 'run-round'. Sometimes the infection spreads from one side of the base of the nail to the other lifting the nail completely off its matrix and finally the nail is cast off, or detached all along its base. Sometimes the soft and delicate nail root under the epionychium is raised entirely off the nail bed although the



Figures 24 and 25

#### Subcuticular Whitlow.

(b) **Periungual whitlow or Paronychia.**—This variety of whitlow is very common and begins usually on one side of the nail as a simple infection in the superficial layers of the skin. It is generally due to some slight injury such as brushing against a stone. As people walk barefooted, dirt accumulates round about the nails between the nail and the epidermis, particularly under the overhanging nail, between it and the skin margin. The injury acts as an exciting cause and infection readily starts. Sometimes, it is found in association with ingrowing toe nails.

distal exposed portion of the nail might still be attached to the matrix.

**Treatment** is on the same lines and principles as that of paronychia in the hand. Evacuation of pus in the early cases followed by aseptic dressings is sufficient. If it is a 'run-round' two separate incisions have to be made on either side parallel to the side of the nail sulcus. If the pus spreads under epionychium the following procedure is adopted as in the case of the hand. The incision is so made that a rectangular flap of skin with a proximal base

is fashioned. It is first made transverse 2 mm. proximal to the nail. It is then branched upwards on each side at a right angles to the first incision, while keeping parallel to, but outside, buried edge of the nail. The skin flap is raised by knife dissection which exposes the lesion. The upper part of the nail is detached. If the distal part is still adherent the proximal detached portion has to be scissored and removed leaving the adherent portion in place. "Ring" anaesthesia as advocated by Iselin can be used with advantage. Recovery is prompt and it takes about a week or 10 days for the wound to heal.

(c) Sub-ungual whitlows:—These are common in the great toes. The usual history is that of a weight falling directly over the great toe or stubbing of a toe on the roadside resulting in sub-ungual haematoma. This offers



Fig. 26  
Paronychia—II Toe, Lt. Foot.

a good focus for infective organisms and pus collects. The usual symptoms and signs of pulp infection such as, throbbing pain in the great toe, tenderness, warmth, swelling and redness in fair-skinned people will be met with. If it is treated at this stage by effectively letting out the pus, it heals quickly. Otherwise, the infection spreads under the nail involving the whole nail bed. Pain is very severe and the patient cannot walk. After a day or two it bursts at some para ungual point—usually,

at its distal free portion—pus escaping in small beads but insufficiently. The symptoms are now less in severity, but the pain and tenderness persist on walking. The infection ultimately travels down via the lymphatics to the periosteum and sets up an osteitic reaction, the diaphysis finally separating as a sequestrum.

**Treatment:**—"Ring" anaesthesia. Incision and letting out of pus at the point of maximum tenderness. A triangular piece of that portion of the nail over the area involved is excised in order to expose completely the focus of suppuration. Healing is rapid, and the nail grows without any deformity. Most of the cases that



Fig. 27  
Onychia.

come to the hospital are in the last stage, complicated with osteomyelitis. The treatment at this stage is different and is dealt with later.

## II. ACUTE SPREADING INFECTIONS.

Under this head come infections which involve both the skin and the subcutaneous cellular tissue. It is neither pure lymphangitis nor frank fascial space infection. It is differ-





Fig. 28  
Before Treatment



Fig. 29  
After Treatment

Acute Spreading Infection  
Left Foot and Leg.

ent from lymphangitis in that the skin also is involved in the inflammatory process.

Similar clinical manifestations also occur in the upper limb. The course of the disease varies. It may be a *strep* lymphangitis or it may be accompanied with formation of distant abscesses. Filarial infections are excluded from the purview of this paper as they form a distinct clinical entity though some of the manifestations may be of the type described be

bleb the skin was erythematous and there was another bleb in the calf. The plantar aspect of the heel and the sole were free. Skin over the leg was granular to feel and also to appearance. Lymphatic oedema of the whole of the foot and leg. The knee area above was free. Gristle glands tender, warm and discrete."

General condition was fair, temperature 99.8°, tongue coated *sl* / "ent had bronchitis in addition."

and staphylococci. A swab taken for culture grew both strepto and staphylococci.

The swelling came down on the third day within 48 hours. Later the wounds were dressed with one per cent. aqueous Gentian Violet once a day. The general condition markedly improved by the third day, and there was no rise in temperature.

The patient was discharged on the 12th day, the wounds all healed. He reported in person six weeks later. He has no disability with regard to locomotion or weight bearing.

#### CLINICAL FEATURES:—

The initial lesion is always small. A scratch or a pinprick which, in the majority of cases, is situated on the dorsal surface. The incubation period is short. Signs of infection develop within a few hours. In other cases the infection may appear to follow a mild course and then quite suddenly and on account of secondary infection or trauma, the condition worsens in a few hours.

The skin of the foot and leg up to the knee presents a shining appearance. Infiltration of the tissue begins and is more prominent on the dorsum of the foot and anterior aspect of the leg due to the looseness of the subcutaneous cellular space. On palpitation, the skin has a granular feel, the movements of the joints are limited on account of the swelling and pain. There may be regional lymphadenitis.

**COURSE OF THE DISEASE:—**Severe cases end fatally within a fortnight.

"A young boy had a prick in the heel with a nail; 7 days later he was brought in very ill and toxic with intense swelling of the dorsum of the foot and leg, and showing pus pockets in the heel at the site of the original wound. The pus pockets were drained well. Two days later he rapidly developed gangrenous patches in the heel and around the posterior and lateral aspects of the ankle. Excision of these patches of skin was done and the wounds dressed with streptocide. Streptocide was given orally also but the patient showed no improvement and the gangrenous process in the wound spread. He died of toxæmia on the 13th day of the disease and on the 6th day of admission."

In some cases the lesion is not so extensive and severe. The gangrenous process is localised and destroys only a part of the skin. If these cases are tackled early they turn favourable and improve steadily though slowly. It takes nearly seven to eight weeks for these patients to get back to normal work.

**Treatment** is mainly general till infection gets localised. **General treatment** is to maintain the strength of the patient by all available means. The use of Chemotherapeutic drugs, sulphonamides orally or even parenterally in severe cases is commended. Toxaemia should be combated by giving glucose and saline intravenously. Severe cases can be treated with penicillin particularly if the case is sulpha resistant.

**Local Treatment:—**The wound of entry is examined, opened and excised. During observation any collection of pus in a local area should be let out ensuring good drainage. If gangrene develops, it should be allowed to localise before it is excised. All procedures should be aseptic. Once the infection is controlled, the limb is rested in a plaster splint, the wounds being dressed once in 3 or 4 days or at longer intervals.

### III. DEEP INFECTIONS.

#### (a) Whitlow of the pulp of the toes:—

Corresponding to the whitlow of the finger, they are sometimes found as a result of accidents—crushed injuries or open wounds or a thorn prick or a glass cut. Blood borne infections are uncommon and when they do occur they are of the same type as those in the fingers and the treatment also is the same. The incidence is very low when compared with that of the fingers. There was only one case in the whole collection of the cases and is described below:—

"Mrs. A. S. R., H. F. 35 years, developed boils over the forehead, nose, chin and the body diffusely. She was given sulphonamides for that condition. Five days later as the boils were subsiding she developed pain of a pricking nature in the right great toe. The pain grew worse in three days' time, when she came under our observation. The great toe was slightly swollen, and very tender in the plantar aspect. There was a subcuticular abscess

in the outer aspect of the under surface of the great toe. The pus was let out and dressed with streptocide powder. She was put on cibazol gm. 1. three times a day. The pain did not subside but, on the contrary, increased; it was throbbing in nature and the patient could not sleep at night. On the third day, pulp infection was diagnosed, and under general anaesthesia an incision and a counter-incision made as for pulp infection of the thumb; about  $\frac{1}{2}$  cc. of pus was let out and through and through drainage effected. The pain came down the next morning. The drainage tube was removed on the third day after incision. Warm saline baths and streptocide dressing were given for ten days, when the wound was healthy and there was no more pus. Later the wound was dressed on alternate days with 1% aqueous gentian violet. The wound healed in 27 days."

#### (b) Cellulitis:—

Most of the infections of the foot start in the toes, or proximal to their bases on the plantar aspect. The later course, however, depends on the routes of spread and the virulence of infection. The routes of spread are:—

- (1) Fascial spaces,
- (2) Lymphatics and
- (3) Both.

If the spread is by fascial spaces it results in local inflammation and cellulitis around the seat of lesion. The spread is fairly slow and and if virulence is not severe and relief comes early, the resolution is complete and loss of tissue and function is very little.

If the spread is by lymphatics there develops lymphangitis, lymphadenitis and, in unfavourable cases, septicaemia and even death. This kind of infection is the most serious as regards immediate mortality, but once the crisis passes, is the least apt to cause permanent disability.

The infection spreads by both the routes in "acute spreading infections of the foot" wherein there is local inflammatory reaction with cellulitis and distant metastatic formation of an inflammatory focus leading to suppuration somewhere along the course of the lymphatics that drain the area. In severe cases, there is severe general reaction and the

inflammation at the original seat of infection may lead on to gangrene. This variety of it, has already been described to some extent and more will be said about it later.

Frank cellulitis with local spread, or general reaction or spread by the lymphatic route, is rare. When the infection is of a mild degree and when the patient happens to be a diabetic, or has albuminuria it spreads along the fascial spaces, fairly rapidly. If treatment is given early in the course resolution is complete in spite of the patient being a glycosuric.

"N.P., 50 years, history of an injury 12 days before admission over the plantar aspect of the web between the great and the second toes of the right foot. Two days later he developed a swelling over the dorsum of the foot proximal to the root of the second and third toes. It burst and discharged pus on the fourth day. The wounds were painful since then and he was unable to walk or bear weight on the foot.

On examination, the whole of the dorsum of the foot was swollen. There was a big ulcer on the dorsum of the foot 4" x 1 $\frac{3}{4}$ ", irregularly ovoid with pink elevated edges, pus oozing out and lots of slough exposed. Some areas of the edge of the ulcer showed greyish black slough turning gangrenous (?). There was a wound in the sole at the root of the second toe discharging some pus. General condition fair; urine—sugar about 1 per cent., phosphates plus; albumin nil.

Treatment:—Without anaesthesia—debridement of the wound, sloughs removed. Dressing with streptocide was given. The foot was elevated on pillows to facilitate drainage. Insulin was given to regulate glycosuria. The ulcers improved and were healthy looking and the swelling over the dorsum of the foot disappeared by the fourth day. 12 days after admission, he developed two abscesses over the dorsum of the foot, one at the base of the first metatarsal and one distal to the medial malleolus. These were opened and drained. 20 days after admission all the wounds were healing well. All the ulcers healed and he went home walking. He stayed in the hospital for two months."

## (c) Gangrene:—

Gangrenous infections of the foot are very common. The foot is the seat of pathology in the case of senile gangrene. Here, the gangrene is usually of a dry type and infection is minimal. It is chiefly due to impoverished blood supply of the foot due to arterio-sclerotic changes, particularly in the smaller arteries of the foot, generally the big toe. The gangrenous process may commence after a slight trauma when there develops a small ulcer with a central black necrotic area. This process may slowly progress and lead on to inflammatory senile gangrene. It may also start as a result of a thrombus forming in and occluding the tibial vessels, when the toes begin to shrivel up and die without any evidence of local inflammation. Pain is a marked feature and as the disease spreads it becomes unbearable and the patient gets insomnia and exhaustion, unchecked. The termination is fatal and may be hastened by septic fever, bed sores or pulmonary, cardiac or renal complications.

Treatment is invariably amputation, once gangrene sets in. The level of amputation has to be decided so as to be well away from the seat of necrosis ensuring the circulation of the flaps of the stump. If a major part of the foot is involved it is generally done through the lower one third of the thigh. If the general condition does not permit of an amputation, the affected area is protected by a dressing to prevent the access of sepsis and the general condition improved by suitable tonics, nourishment, stimulants and analgesics to ensure sleep.

The other main types of gangrene may be classified as follows:—

- (1) An acute spreading infective condition ending in gangrene formation;
- (2) Diabetic gangrene, and
- (3) Gangrene secondary to infection after crushed injury or compound fracture.

(1) Some of the cases which start as 'acute spreading infections' on localisation develop gangrene. Sometimes, it happens that a simple infection of the toe after an injury passing through a fairly normal course suddenly becomes gangrenous over a more or less extensive area. There must be occurring

arterial thrombosis which comes on without apparent cause and without warning. The general health of the patient does not appear to be of any special significance. However, diabetes seems to have a role in the development of the gangrene.

"J.W., A.I. 45 years, developed two shoe bites one on either margin of the right foot. He could not discard the shoes nor could he give rest to the foot. In one week, the whole of the foot swelled up, became painful, and he could not walk.

On admission, the patient was toxic, temp. 100° F., with moderate general condition.

The whole of the dorsum of the right foot and the lower 2/3rd of the right leg were swollen. The one shoe bite wound at the root of the little toe contained a bead of pus while the other had already healed up under a scab.

In the centre of the swelling in the dorsum of the foot, the skin was dark over an area 2" x 1½" with sub-epithelial collections of lymph at the periphery. Lymphatic oedema of the tissues was present up to the junction of the middle and upper 1/3rd of the leg. Glands in the groin enlarged; tender, showing evidences of inflammation. Urine free from sugar and albumin.

**Treatment:** Without anaesthesia the blebs were laid open. The necrotic patch of the skin was cut out, sloughs beneath the skin were removed as far as possible using gentle traction. Wound was dressed with streptocide and bandaged and limb kept elevated resting over pillows. Smear of pus with gram's stain revealed streptococci. Culture report was "Haemolytic streptococcus grown in culture." Patient was put on streptocide gm, 1 thrice daily.

The next day general condition showed definite improvement. Plenty of sero-sanguinous discharge was oozing out of the wound. In ten days, swelling came down completely. The wound was regularly dressed with streptocide once in three days. A month later, the wound was clean granulating well, and showing epithelialisation.

## (2) Diabetic gangrene.

Gangrene of the lower extremity in the diabetic manifests itself in two forms:--

- (a) The uncomplicated ischaemic necrosis, typical of the non-diabetic arteriosclerotic, commonly termed 'dry gangrene'; and
- (b) The septic necrosis known as 'moist gangrene' which takes place in the presence of fairly good blood supply to the limb.

The dry variety is the senile type when gangrene sets in in a limb where the blood vessels have been grossly narrowed down and the collateral circulation not well formed.

The latter condition is not a result of vascular occlusion but of the culmination of a series of changes. Slowly progressive intimal thicken-

ing permits the development of collateral circulation until eventually a delicate balance between life and death of the tissues is reached. When gangrene occurs it is more often the result of increased demands of the tissue cells due to the metabolic disturbances of sepsis and diabetes than to an immediate decrease of blood supply. Local bacterial invasion initiates or attends the development of this process and soon becomes the dominating figure. The combination of sepsis and persistent but inadequate blood supply result in a moist spreading gangrene, which, untreated or unchecked, causes death. If the tissue metabolism be returned to normal the blood supply would again be adequate and the necessity for amputation as a primary therapeutic measure become less. So in the presence of a spreading gangrene if infection be eliminated and the diabetes with its disturbed metabolic process

## Acute Spreading Infection, Foot, Ending in Gangrene.



Fig. 30

Note the intense lymphatic  
Oedema with central necrosis.



Fig. 31

After debridement swelling disappeared  
wound granulating well.

and abnormal cell needs be controlled, the gangrene would not recur.

In the first variety the patient gives a history of intermittent claudication a short time before the onset of actual gangrene. The pain is severe, burning, or shooting in character and out of all proportion to the extent of the lesion. The pulsation of the dorsalis pedis and the popliteal as well may not be felt. The difference in temperature between the limbs is apparent, the affected limb sometimes feeling actually cold.

The circulation being poor and the pain very severe, it is ideal to do a high amputation through the leg or lower 1/3rd of the thigh in this dry type of gangrene as early as possible.

In the other variety the history of the intermittent claudication will be of a long duration and the pain not so severe. The popliteal and the dorsalis pedis do pulsate and the warmth of the affected limb not much diminished.

**Treatment:**—Essentially falls under two heads:—



Fig. 32.

Diabetic Cellulitis and Gangrene.

(1) **General.** Rest in bed. Restoration of normal protein and plasma level by transfusion and by giving plenty of fluids by bowel and by mouth.

One should not worry much about the blood sugar level to be brought down very quickly. Diet with plenty of carbohydrates, moderate supply of protein and minimum of fats to be given.

Insulin and protamine zinc insulin are to be given to regulate the glycosuria. If acetoneuria is present glucose should be administered intravenously supplemented by insulin.

Chaemotherapeutic agents like sulphathiazol in fairly massive doses help towards controlling and bringing down the infection. They should be continued till three or four days after the infection is brought under control.

Penicillin, 15 or 20,000 units, every three hours given intramuscularly as an adjunct to local surgical treatment is of immense help towards rapidly controlling the infection. After the advent of penicillin the progress of these cases is very good.

## (2) Local.

(p) Prevention of extension of local infection by keeping the limb horizontal in bed (not elevated) and at rest, the part being periodically irrigated with eusol solution. The part is then kept covered with sterile gamgee pads only. This helps towards localization of the infection and separation of sloughs.

(q) Removal of gangrenous area—This is a slow and prolonged process. The sloughs as they separate are removed applying very gentle traction, every time removing as much as possible.

(r) Stimulation of circulation and of growth of granulation tissue and new epithelium. The following are advocated and found useful:

- (1) Intravenous injection of 5% saline or glucose about 50 c.c. a day.
- (2) Nicotinic acid tablets by mouth—massive doses.
- (3) Perandrin—subcutaneously once in 2 or 3 days.
- (4) In the later stages, U.V. ray exposures to the wound.

**(3) Traumatic Gangrene:—**

Gangrene secondary to crushed injury and compound fracture—In this variety, if gas gangrene is excluded the aetiology of the ordinary gangrene is not well understood. It is supposed to be due to a more or less synergistic action of strepto and staphylococcus. The streptococcus is the main aetiological factor to start with, the staphylo appearing after the gangrene has manifested itself. And it is the staphylo that persists in the latter part of the course.

In this group there is damage to soft parts and blood vessels and nerves resulting in direct infection. With loss of blood supply and also poor venous return, gangrene readily manifests itself and loss or damage to tissue is often extensive.

**Treatment:—**(i) Prophylactic—All crushed injuries and compound fractures should be well explored under anaesthesia, thorough excision conducted and ruptured vessels identified and tied. The wound should be etherised and freely plastered with streptocide and closed leaving a good sized drainage tube or two as the case demands; the drainage tube always should be brought out through a separate stab incision in the skin at the dependant part of the wound. Tension in stitching is to be avoided. If unavoidable relaxing incisions may be made or the wound left packed, not sutured. Reparative surgery can be thought of after the wound has healed or after all danger of infection is over. The limb should be immobilised in plaster.

Preliminary A.T. serum 3,000 units and A.G.G. serum 4,000 units should be given for all cases.

(ii) Curative—When the case comes late and infection and gangrene threaten, formal debridement of the wound or, better, an enlargement of it so as to facilitate free drainage, should be done. Sulphanilamide groups of drugs are to be widely used by freely applying it locally and by mouth or even by injection. In case of severe infection or gross contamination or extensive involvement of the extremity penicillin will be the ideal drug to be used. If in spite of all these efforts gangrene supervenes or the case comes with gangrene already set in elective amputation is imperative.

Among other varieties, gangrene due to (i) Embolism and thrombosis; (ii) Thromboangitis obliterans and (iii) gas gangrene will be considered now.

(i) **Embolism and thrombosis.** The common source of an embolus (simple) may be due to the separation of a vegetation from one of the cardiac valves or possibly an atheromatous plaque from the aorta or one of its main branches, or a mural clot detached from the left auricle during an attack of auricular fibrillation. The other types of emboli are infective embolus, malignant embolus and the parasitic embolus. The gangrenous process slowly spreads and finally stops at a level where the circulation is intact and sufficient. It generally involves the whole foot and demarcates slightly above the level of the ankle joint.

Treatment is amputation after the line of demarcation has established itself. Till then aseptic conditions should be maintained in the affected part. If the part becomes infected, amputation should be done at a higher level.

(ii) **Thromboangitis obliterans:—**The gangrene that follows this affection, is never an extensive one, and by itself not a distressing one. It starts long after the impoverishment of blood supply establishes itself. It is the cramplike pains even after slight exercise and recurrent or continuous pain due to involvement of nerves in the perivascular fibrosis that is distressing. Phlebitis of superficial veins adds to the discomfort.

**Treatment—**(1) Eschewing of tobacco; (2) Intravenous glucose 5% solution; (3) Exercises to the limb to improve circulation; (4) Sympathectomy—either lumbar or periarterial of the femoral artery in Hunter's Canal. The last method has given very good results in many cases and helps in the healing of the ulcer. The gangrenous process usually involves a small area. After sympathectomy, a debridement should be done and the wound dressed only once in a week. Simple dressings with 1% aqueous gentian violet are quite sufficient. The wound heals very slowly.

(iii) **Gas Gangrene.** Though rare it is often the fatal sequel to many a roadside injury. Any extensive accidental wound, be it a crushed injury with extensive laceration or a compound fracture, or a compound fracture with

a punctured wound, if contaminated with garden soil is liable to have gas gangrene develop in it. Extensive haemorrhage with blood clots in the wound and much lacerated tissue, particularly muscle, are the necessary media in which the causative organisms thrive and multiply with rapidity. These organisms fall under two groups, the saccharolytic—*B. Perfringens* (Welchii) and *Proteolytic*—including *B. Sporogenes*, *aerogenes capsulatus* and *oedematis maligni*. Owing to the lysis these organisms set up all the tissue is dissolved and gases emanate, the final ones being carbon dioxide, hydrogen and hydrogen sulphide. The last is responsible for the offensive odour associated with it. The infection spreads rapidly along the muscle fibres, groups of muscles being attacked simultaneously.

The clinical features develop within 48 hours after the occurrence of the incident. The actual signs are those of toxæmia—a rapid pulse with a rise or in severe cases a fall in temperature and vomiting. The toxins are supposed to exert a depressing effect on the suprarenals resulting in a fall of blood pressure and consequent vomiting; swelling is greater than usual and the pain more than what the injury would indicate. There is marked mental alertness. The muscle colour and appearance vary but changes are always present. It loses its healthy red appearance and swells up. It is puffy and dull red in colour. The colour changes rapidly to green and then to brown and black. When it is black it loses all its structure. It is disintegrated and is mere foul-smelling frothy mass and no longer muscle. The skin is pale to start with, later appearing brownish. In some cases crepitus may be found on the first day and in a majority the second day and only in a few—later. In the more toxic oedematous cases the crepitus is obscured by the oedema and hence its recognition may be delayed till the second, third or fourth day.

The edges of the wound are of a dirty tint with pouting of the lips. Exudation is not much and is brown in colour becoming offensive in later stages.

Treatment is essentially prophylactic. All wounds are treated on the same lines as those dealt with under the traumatic group of gangrene.

A.T.S. 3,000 units and A.G.G. serum 4,000 units should be given intramuscularly. In all wounds where gas gangrene is likely to develop a careful watch is to be kept to detect its earliest signs. If the infection becomes established, multiple free incisions, local excision of groups of muscle or amputation may be necessary according to the extent and virulence of infection. Amputation stump wounds must be left open and secondary sutures applied after making sure that the infection has been controlled. Drainage tubes should always be left in the wounds.

The sulphanilamide group of drugs have very little or no effect on this group of organisms, but penicillin has a powerful effect.

### GAS INFECTION:

Sometimes the injury may not be severe and yet the wound may primarily be infected with gas producing organisms. If the wound is only subcutaneous tissue deep and does not involve muscle, these organisms may still thrive as evidenced by the production of gas and crepitus in the surrounding parts. The presence in the wound of foreign bodies devitalised tissue or blood clots due to imperfect or no attention to the wound, inadequate drainage or imperfect debridement definitely favour the survival and growth of these organisms. The gas collects subcutaneously and spreads up slowly in the same plane. Treatment consists in excision of the whole of the skin and subcutaneous tissue involved and dressing with sulphathiazole powder dusted on the wound. Care should be taken not to be too scrupulous in the debridement and not to injure the muscle tissue deep down. Penicillin in 15,000 units doses every three hours given intramuscularly controls the infection readily.

### IV (a). ABSCESSES.

#### 1. Abscesses of the Foot:—

The average man in South India goes about bare-footed. As a result of this, the sole of his foot gets thickened all along the area that comes into direct contact with the hard ground. This area includes the region of the heel, that over the heads of the metatarsals and a narrow strip along the lateral border of the foot. Here the epithelium is markedly hypertrophied and presents certain special features. It



cracks all along the heel margins\* and along the inner margin proximal to the great toe. Infection readily spreads down into the deeper layers through this route. Secondly, all over the heel there are found in most of them a number of dark spots which on closer examination are revealed to be either small pittings or deep holes of fine calibre. Infection is very likely to spread down through these. Generally this infection causes a local reaction and it does not easily spread around due to the thickness of the epithelium. An abscess forms and is subcuticular or subcutaneous. The former variety is more common than the latter. The subcutaneous abscess is the commonest in the heel.

#### Abscess Heel.

The epithelium of the heel is very thick and presents cracks and fissures with small pittings as described at the beginning of this chapter. The subcutaneous tissue is a thick pad of fat which is firm and granular. It is lodged in the interwoven meshwork of fibrous strands that stretch between the skin and the deep fascia. This subcutaneous space is localised and small. It is only continuous forwards and distally along the outer border of the foot. Any small collection of inflammatory exudate in this area causes therefore intense throbbing pain which can only be compared to whitlow of the pulp of the fingers.

The deep fascia covers the periosteum and the origins of the muscles from the tuberosities of calcaneum and is continued forwards as the slips of the plantar aponeurosis.

Plaster of Paris mixed with glycerine and water is injected to define this space. Very great pressure is required to inject the material into the spaces. X-ray reveals the location of the material and its characteristic granular or beaded appearance and the extent of the heel space. The tendency seems to be to spread out posteriorly where it may get into the sub-epithelial layers and try to burst through or spread up.

The route of infection has always been difficult to assess. But in cases where there are cracked heels it is easy to understand the route of infection. But usually abscesses also

occur in cases where the heel is not cracked and the skin is intact; and it generally happens in accidents in which pressure as on treading over a sharp stone, or a prick by a thorn or a nail, or a glass cut, play their part as predisposing factors and routes of infection.

Owing to the special structure of the subcutaneous tissue even if the quantity of the exudate or pus is small pain is very severe. As this pocket gets filled up, it tries to break through the layers of the skin.

The incision to drain this abscess should always be along the lateral margin of the heel. A counter incision is made on the opposite side and a double drain put in. The drainage tubes should be removed in 24 to 48 hours. Later the case can be dressed with streptocide. From the third or fourth day the pus stops oozing from the wound. The patient should be encouraged to walk bearing weight over the heel after a week. This ensures closure of the pocket and quicker healing. It takes about three weeks before the wound heals completely and the patient can walk freely. If there are secondary blebs they have to be snipped off and dressings with streptocide applied.

Incisions to be made for abscesses in the sole of the foot and the heel in particular should always be in the line of the main vessels and nerves. They should always be in the sides where there is no weight bearing. Wounds of the sole should never be drained or incised through the dorsum of the foot, between the metatarsals as it entails widespread infection. Once incision is made and the wound is healing, the outlying cuticle should never be trimmed or removed. It should be allowed to fall off by itself because it will serve as a protective layer for the new forming skin that is to get accustomed to weight bearing on rough ground.

**Subcuticular abscesses:** They are usually seen at the dorsum of the foot or in the sole. They are generally localised in the thickened epithelium of the sole. They should not be confused with the infective bursa in callosities where similar conditions may be present. Left to themselves they invariably burst and drain automatically. If allowed to burst by themselves they are painful and it is better to open them as quickly as can be done to help rapid healing.

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\* These cracks and fissures in the foot are one variety of cutaneous manifestation of ringworm in the foot.

**Collar-stud abscesses:** This type of abscess is common in the plantar aspect of the foot over the region of the balls of the toes. Here the epithelium is cornified and dense. It may exhibit cracks in the superficial layers particularly in the labour class. Infection tracks down via lymphatics through those cracks and starts inflammation under the epidermis. It

that is more involved than the subaponeurotic.

The subcutaneous space in the dorsum is generally involved in all types of acute spreading infections leading on to a diffused cellulitis and swelling of the tissues. Once the acuteness of the condition passes off it generally subsides

#### ABSCESS HEEL.



Fig. 33

Note the pittings and the cracked condition of the sole.

finds it difficult to work its way through the thickened layers of epithelium and hence burrows through the dermis and spreads under it thus producing a 'collar stud' abscess. The pain is severe and does not get relieved with mere letting out of pus from the superficial pocket. It requires a deep incision well draining the deeper layer also.

#### (2) INFECTION OF FASCIAL SPACES:

Infection of the various plantar spaces particularly the median plantar spaces is very rare. I have not come across a single case wherein a median space is involved. Of the two lateral spaces it is the lateral plantar space that is more involved but even that is rare. Infection of the inter digital commissures or webs is fairly common and the infection readily spreads to the dorsum and may set up a subcutaneous infection of the dorsum of the foot. Even in the dorsum it is the subcutaneous space



Fig. 34

or gets localised developing a circumscribed area with necrosis and destruction of the skin and subcutaneous tissues often exposing the tendon sheaths in the depths of the wound. This has been dealt with under "acute spreading infection of the foot."

The subcutaneous interspaces are posterior in their situation to the web spaces. Infection in them is localised with lymphatic oedema developing rapidly in the dorsum of the foot. If the virulence of the infection is severe or if the case is complicated with diabetes or albuminuria the infection readily spreads into the lumbrical space and also into the median plantar spaces, M-II, M-III and M-I.

In the diabetic, infection starting after trivial injury to the digits may spread up rapidly

as cellulitis. In some cases the infection travels down to the plantar aspect by way of the lumbricals and tracks down to the median plantar spaces M-II and M-III. Cellulitis in the dorsum of the foot spreads down deep into the sub-aponeurotic space also; it may also be secondary to a spread through the interosseal from the M-III space. The infection is severe and the prognosis is grave, the case generally ending in amputation. In some cases the infection may spread through M-III to the medial M-I space, track upwards and set up distant metastasis in the calf. In others such metastasis may result from tracking up of the infection from the dorsum of the foot along the lymphatics accompanying the saphenous veins to the upper part of the leg or the lower part of the thigh. These are particularly bad cases and in spite of early high amputations the mortality rate is high.

**COMMISSURE INFECTIONS:—**There are commissural or web-spaces between the toes similar to the spaces between the fingers, but whereas there are only three of them between the inner four fingers in the hand, there are four in the foot. Of these, the space between the great and second toes is the biggest and is the one more often involved than the others.

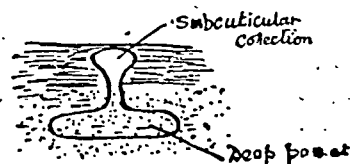
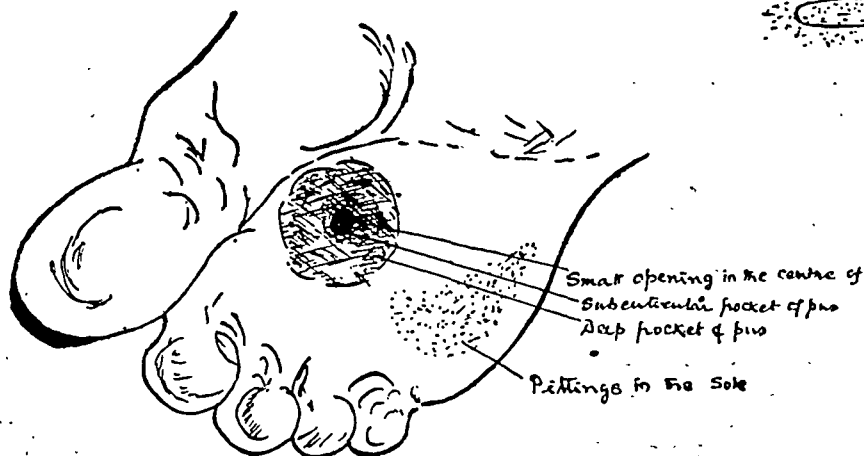
These web-spaces in the foot are bounded on the plantar aspect by the skin, distally by the fold of the skin forming the web, dorsally by the sub-aponeurotic and subcutaneous layers of fascia, laterally by the adhesion of the skin to the pretendinous digitation of the plantar-aponeurosis and proximally by adhesion of the skin to the transverse fibres of the



Fig. 35

Fig. 36

### COLLAR STUD ABSCESS (Explanatory Diagram)



plantar-aponeurosis stretching across the digital slips.

These spaces have no direct connection with the dorsum of the foot by continuity of space. Infection can travel only by the lymphatics which traverse the spaces in their course from the plantar aspect to the dorsum of the foot.

Infection is invariably after a thorn or a nail prick. To start with the pus is localised in the small space described above. From there it spreads to the dorsum of the foot through the lymphatics. In mild cases there is a slight swelling of the dorsum of the foot at the bases of the toes only. But in severe cases the whole of the foot is swollen and an acute spreading infection may supervene. Left to itself the pus breaks through the skin in the plantar aspect.

**Clinical features:**—Pain is localised to the web. There is swelling of the web space with symmetrical swelling of the roots of the adjacent two toes. The movements of these two toes are possible but painful.

Treatment is to let out the pus through a plantar incision with a counter incision through the dorsal aspect of the web. A through and through drainage is to be instituted through these incisions. If the infection spreads to the dorsum of the foot and localises there that cavity has also to be drained.

#### (b) OSTEOMYELITIS.

Osteomyelitis of the small bones of the foot is not very common. It is mostly seen in the terminal phalanges secondary to infection in the soft parts. In crushed injury if the wound were not attended to properly the involved bone may be directly infected with the development of osteomyelitis. Blood borne infection rarely settles down in any of the bones of the foot.

In the terminal phalanges infection may start in the subcutaneous tissue after a slight trauma or it may start as paronychia or onychia. When left untreated the infection involves the nail bed. The nail is shed off in part and the infection becomes chronic. Later it tracks down via the lymphatics and involves the distal portion of the terminal phalanx. It sets up an osteitis and destruction of the terminal portion of the diaphysis. Some of the

patients come at this stage when the digit shows a club-like swelling with ulceration of the whole of the terminal portion. The nail will be missing entirely or in part. There is dark brown or ash grey slough covering the floor and granulations are very unhealthy. Pain will be very severe. An X-Ray shows rarification of the terminal portion of the phalanx. Almost all these cases show, in addition to strepto and staphylococci, Vincent's spirochaetae and Fusiform bacilli which are associated with tropical ulcer.

**Treatment:**—The wound is dressed with streptocide powder and when it is becoming healthy partial amputation of the digit removing the distal portion of the terminal phalanx leaving the base intact is performed. If the case comes early scraping of the floor of the ulcer and excising the whole of the nail bed will bring about fairly quick healing. In diabetics when the infection in the cellular spaces is severe it may go deep down to the bone and set up an osteomyelitic reaction in more than one bone. In these cases treatment is amputation.

Sometimes, infection may develop in the calcaneus and set up osteomyelitis. These cases may be accompanied by a deep infection in the heel. In treating these cases the heel bone is split in the midline and laid open until the infection is controlled and then brought back and put in plaster in the healing stage, reforming the heel. It gives excellent results.

#### V. TENDON SHEATH INFECTIONS

The tendon sheaths round the ankle are the ones that are more likely to be inflamed. Infection of the digital sheaths is rare. They may be inflamed as a result of injury or get infected by pyogenic organisms, gonococci or tubercle bacilli.

Tenosynovitis may be acute or chronic. Acute tenosynovitis is generally traumatic in origin but is rare in the foot. Acute infective tenosynovitis also is very rare. In some the infection may have been carried by the lymph vessels from an adjacent cellulitis. I have not come across a single case of acute tenosynovitis of any tendon sheath—neither pyogenic nor gonococcal.

Chronic tenosynovitis is invariably tuberculous, the sheaths of the peroneal or extensor

tendons being commonly involved. The disease attacks young adults and may be the only manifestation of active tuberculosis. In the early stages a serous exudate is present, later granulation tissue with the appearance of 'melon seed' bodies; in late stages and in the severe forms extensive caseation may occur. In early cases, the tendons may be thickened as a result of proliferation of their visceral sheaths, but they are healthy. In severe cases a single tendon or a group of tendons may show destruction.

**Treatment:**—If the osseous tissue around is not involved and if the tendons are not destroyed, excision of the diseased portion of the tendon sheaths ensures eradication of the infection. Otherwise the prognosis is very grave.

"Mrs. B. N. F. 22 yrs. admitted for the treatment of pain in the left heel, duration two months. The pain started as pricking sensation in the outer aspect of the heel and was gradually increasing in severity. She was unable to bear weight on the heel or walk since a week from the date of admission as it caused severe pain. The general condition of the patient was good; cardiovascular and respiratory systems normal. She was pregnant, primi and in the 7th month.

Local examination revealed swelling on either side of the heel below and behind the malleoli, on either side of the tendo achillis. Tenderness was present on deep pressure behind the lateral malleolus. Movements of the ankle and midtarsal joints normal.

Operation on the third day after admission under local  $\frac{1}{2}\%$  novocaine—Kocher's incision. There was a lot of fat behind the outer malleolus. So the tip of the malleolus was raised as a ledge. On opening the tendon sheath it was found to be chronically inflamed. It was excised, wound closed in layers and limb put in plaster.

The pathological report of the excised tissue was that it was tuberculous in nature.

On the 8th day, the sutures were removed. The wound did not take below and behind the malleolus. The wound was dressed with streptocide and leg encased in plaster. Dressings continued once a fortnight though a window cut in the plaster. The discharge was gradually getting less and less. Meanwhile, she delivered full-term, normal labour and the baby was born healthy.

After about six months, she developed tubercular synovitis of the right knee joint. This was also treated on regular lines. Now after 22 months the wound in the left heel is healed and the condition of the right knee very much improved. The case is still under observation."

## VI. INFECTION OF THE LYMPHATICS.

Lymphangitis may be either superficial or deep. Deep lymphangitis may end in tenosynovitis or in abscess formation in the deeper tissues. There is a rapid increase of swelling of the whole of the foot and leg with the greatest redness, swelling and tenderness upon the dorsum. Some red lines of lymphatics may be seen running up the leg to the groin or knee. There is no bulging in the sole of the foot though the concavity of the arches may be lost. The patient usually presents great prostration.

The superficial type shows more or less localised reaction. There is usually a history of abrasion or injury of the foot. In a short time the patient complains of all the symptoms of toxæmia—headache, fever, thirst, restlessness and insomnia. Examination reveals an area of suffused redness, readily appreciated in the fair skinned, with swelling of the toe involved. In acute cases there may be no oedema in the dorsum; but usually the whole of the dorsum of the foot gets oedematous. The lymph vessels pursue the shortest course to the back of the foot as in the hand. And so whether the original site of injury be in the webs between the toes or at the base on the plantar aspect of the toe, the dorsum of the foot swells up. If the infection of the foot is along the outer border of the foot or ankle, the popliteal glands show evidences of inflammation. When it is in the other parts of the foot, the groin glands are involved.

## ETIOLOGY, PATHOGENESIS AND PATHOLOGY OF LYMPHANGITIS.

The portal of entry of the infection is often a trivial wound on the toes, an abrasion or a thorn prick or trauma to the toe nail; or the infection may enter through the fissures in the webs in between the toes and along the heel margins, etc. These fissures are very commonly present in the servant class and the housewife in a middle class household where their feet are wet for over 18 hours in a day. This condition in the foot is worse in winter and rainy seasons. Extension of infection is favoured by neglect of minor injuries, lack of protection against repeated trauma or secondary infection. Rest to the lower limb is a thing which cannot be easily attained as it ensues arrest of locomotion, which is impossible.

The exact reason as to why in some cases only minor injuries are succeeded by lymphangitis, is not well understood. The cause cannot be attributed entirely to poor resistance. It is possible that bacteria causing this condition have certain inherent cytolytic attributes causing a severe reaction.

In most of the cases the bacterium responsible is the streptococcus. The staphylococcus enters the field alone only in a small number of cases. Often both strepto and staphylococci together start the trouble. It is suggested that the streptococcus through its rapid spread prepares the soil for the staphylococcus. When this occurs, the prognosis is more grave since the combination seems to increase the virulence of the staphylococcus.

The local changes at the site of injury may be so trivial as to escape notice. The local reaction even in the most severe case that threaten life may be nothing beyond a simple hyperaemia. The inflamed lymphatic vessels are evidenced by their redness and hyperaemia surrounding them.

**Symptoms and signs:** The patient with lymphangitis ordinarily gives a history of slight abrasion, trauma or thorn prick. Often a history of injury may be entirely lacking. There may or may not be local pain in the foot or leg. Generally there is swelling of the dorsum of the foot with a dull aching pain and in some cases the pain and swelling may be severe. In addition there may be present red lines running up the foot or leg which are

better appreciated in the fair skinned. The patient may present varying signs and symptoms of toxæmia—a chill with high or low temperature, headache, anorexia, and prostration.

The following are the usual types met with in lymphangitis of the lower extremity:—

(i) **Simple Acute Lymphangitis:** The inflammatory process quickly subsides. There is rapid disappearance of all evidences of infection both systemic and local. All signs and symptoms disappear in 24 to 48 hours. The red line of lymphatic inflammation disappears overnight. Slight tenderness over the gland area may persist for a little longer.

(ii) **Acute Lymphangitis with minimal local reaction:**

The subsidence of symptoms is prolonged with delayed resolution or even abscess formation at the site of inoculation or in the gland area. The infection is accompanied by mild systemic symptoms.

(iii) **Acute Lymphangitis with serious local complications or systemic involvement:**

There is severe systemic reaction with local or regional abscess formation. The case may end fatally from severe toxæmia before localisation occurs.

### TREATMENT:—

(i) **Local:** Rest to the limb; patient should be confined to bed. A warm application to the limb—ichthylol in glycerine to be painted over the entire area showing swelling and covered by gamgee pads and held in position by a loose bandage.

(ii) **General:**

(a) Plenty of fluids by mouth to keep the system flushed. In severe cases glucose by the intravenous route as often as necessary.

(b) In toxic cases with dehydration intravenous infusion with saline or plasma.

(c) Nicotinic acid 100 to 200 mgm. a day to combat toxæmia is found useful.

(d) Chemotherapeutic drugs like sulphathiazole or next in order of preference sulphamidamide up to 4 gms. a day in three or four divided doses till the infection gets controlled,

(e) Food must be easily digestible and sufficiently nutritious.

(iii) If an abscess develops at the site of inoculation or over the regional glands incision and drainage should be instituted after it gets definitely localised. No incision should be made over the dorsum of the foot simply because it is swollen and there is pain. Tenderness localised at a spot and of maximum intensity at that spot locates the pus correctly and not the diffuse swelling, its size or pain. An ill-advised and untimely incision of the same leads to a fatal end.

### CHRONIC INFECTIONS AND REPEATED INFECTIONS

One infection with streptococcus may not immunise the patient. It may seem almost to favour a second at a later date. The patient fails to produce antitoxins in a degree sufficient to overcome the infection.

### FILARIAL LYMPHANGITIS

A patient may be infected with the systemic invasion of *filaria bancrofti*. This parasite may liberate a number of ova which obstruct the minute lymphatics which get blocked and lead to lymphatic obstruction and thickening of the tissue with slight oedema. Under the pressure of the filaria when there is slight slackening of the systemic resistance there may occur a flare up of streptococcal infection leading to acute lymphangitis with severe systemic reaction. Repeated attacks may lead to chronic swelling of the lower limb which may lead on to elephantiasis wherein the skin and subcutaneous tissues all get thickened. This thickening may attain huge dimensions. There is solid lymphatic oedema which does not pit on pressure. The skin itself may overgrow, become coarse and warty. On the surface of the skin will be seen vesicles which are likely to burst and give rise to a troublesome lymphorrhoea. The thick devitalised skin is specially liable to sepsis, chronic ulceration and lymphangitis.

#### TREATMENT:—

- (i) Acute lymphangitis to be treated as in any other case of lymphangitis.
- (ii) Later followed by one or more of the various methods employed in combating the filarial trouble which are

- (a) A course of filaria vaccine;
- (b) N.A.B. in 0.15 gms. doses given at intervals of a week on three successive occasions; after a month's interval it may be repeated again. Instead of N.A.B. any other variety of arsenic as filarsan or arseno-typhoid or mapharside may be given.
- (c) Calcium chloride 5 or 10% solution 5 or 10 cc. given intravenously at 3 or 4 days' interval helps to reduce the swelling of the tissues considerably, in early cases.
- (d) A course of antimony preparation—Bayer's Foudin or Glaxo Laboratory's Fantorin may be tried with much benefit.

(iii) In advanced elephantiasis amputation seems to be the only recourse.

### VII (a). ULCERS.

Trauma and infection due to pyogenic organisms are chiefly responsible for the formation of ulcers in the foot. Prolonged pressure particularly under the heel, due to faulty application of splints and plaster casings, though not so common, also leads to ulceration. The clinical features, pathology and treatment of these ulcers is the same as for those in any other situation.

Of the many other varieties of ulcers there is one chronic type of an ulcer which is generally described as tropical ulcer. It will be considered in detail.

### TROPICAL ULCERS—NAGA SORE.

Among the chronic infections of the foot and leg the naga sore or ulcer tropicum is the most important. Though it was originally reported from Assam, it has subsequently been reported from almost all parts of India. It is observed widely in Madras also.

#### INCIDENCE:

The following table shows the number of cases of *ulcus tropicum* that attended the surgical outpatient department. The diagnosis was based only on clinical findings which are so characteristic. Hence the number can be taken for all practical purposes to be correct.

**Table IV.**

Incidence of Tropical ulcers in the Surgical Outpatients Department.

Month & year.		Males.	Females & children.	Total.
September 1943	...	23	10	33
October	"	22	5	27
November	"	30	6	36
December	"	28	8	36
June 1945	...	35	18	53
July	"	42	18	60
August	"	64	9	73
September	"	45	11	56

Of these 30 cases have been picked up at random and at convenience and studied with regard to aetiology, bacteriological findings and treatment.

**AETIOLOGY.**

**Age:** It occurs in any age. But it is more common in adults, the majority being below 30 years.

**Sex:** Both sexes are affected but it is more common in the male; girls are more often affected than women.

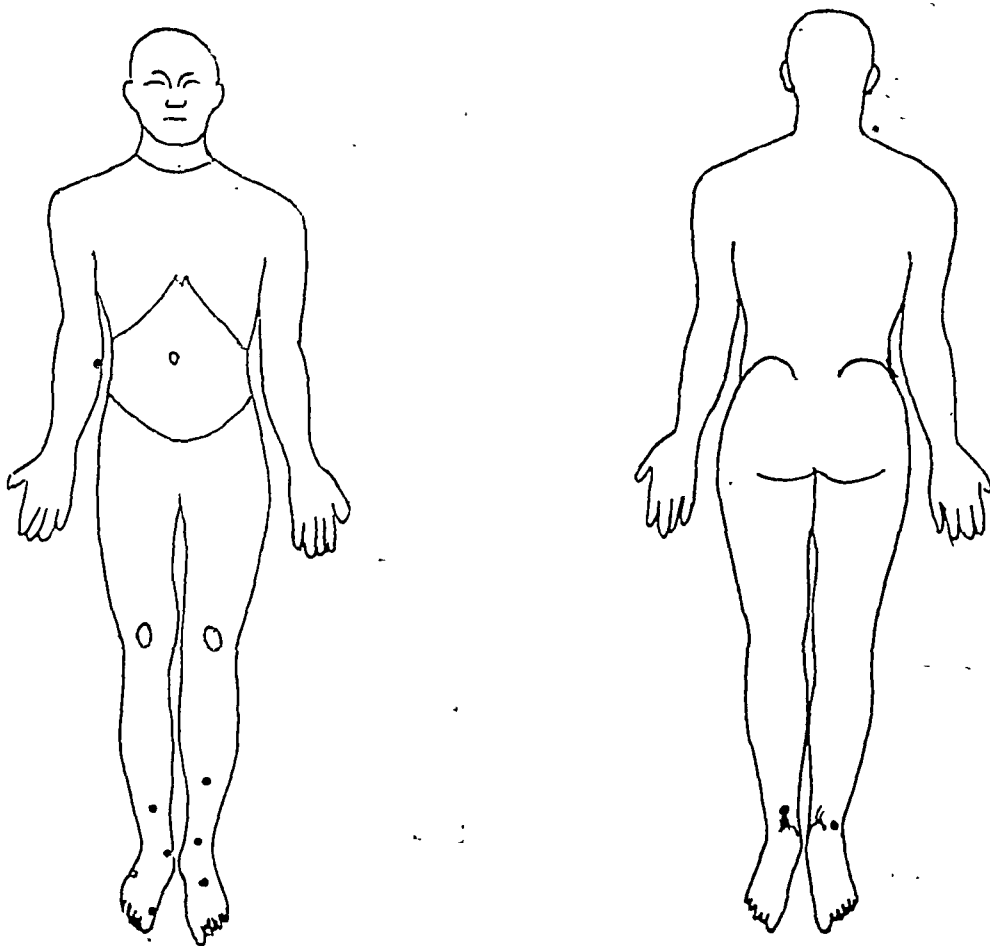


Fig 37. Usual Sites Where Tropical Ulcers Are Found



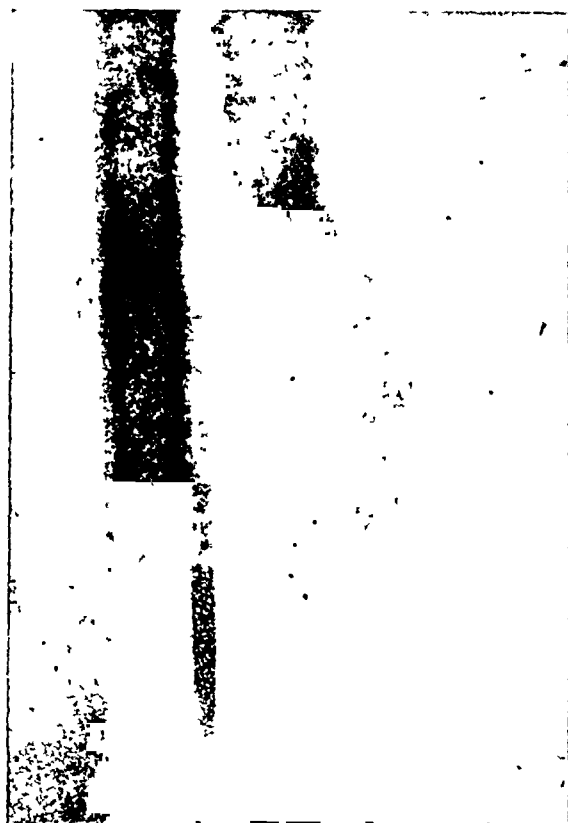


Fig. 46

**Duration:—**

It varies from a week or ten days to weeks or even months. 14 out of 30 cases came with a duration of 1 to 6 weeks and 9 between 6 and 12 weeks.

Table VII.

Duration.	No.
Less than 1 week	2
1 to 3 weeks	7
3 to 6 weeks	7
6 to 12 weeks	9
More than 12 weeks	5
Total	30

**History:—**

The ulcer may start after an injury or abrasion. But many of them say that the trouble started with itching sensation and the formation of a pustule which bursts exuding serosanguinous fluid and leaving typical ulcer.

Of the 30 cases studied the number that gave a history of injury is 18. The rest gave no history of injury.

**Seasonal variation:—**

The incidence of these ulcers is great during and after the rainy season, when the roadside and garden are wet for some days together

**General consideration:—**

It commonly manifests itself in the poor classes of people. Poverty, debility and unhygienic surroundings appear to play an important part.

**Description:—****Site:**

- (a) Over the region of the malleoli.
- (b) Lower part of the leg—chiefly antero-medial surface of the leg.
- (c) Toe — distal phalanx with the nail missing partly or wholly.
- (d) Over the dorsum of the foot.

**Size:**

Varies from the size of a pea to that of a rupee and even bigger in some cases

**Shape:**

Oval, nearly circular, or serpinginous. Irregular in some which are more than 1½" in diameter.

**Margins:**

Clear-cut, regular, sometimes sloping. But on the whole the typical punched out appearance is noted in those over the malleoli and the shin of the leg. In a few of them the margins are undermined slightly.

**Floor:**

Covered with a thick greyish yellow purulent slough. In these cases where the ulceration is still spreading it may be reddish brown or even show frank blood in streaks. The slough is loosely adherent and foul-smelling. When

the slough is removed pale, unhealthy granulation tissue which readily bleeds is seen.

in the early part of the course.

- Depth:** Ulcer is quite deep and reaches the deep fascia or even bone which may be exposed in some cases
- Base:** Is indurated. Not fixed to the surrounding structures.
- Discharge:** Serosanguinous in early days. Purulent and foul smelling later on with a characteristic odour.
- Pain:** Is very severe and the patient spends sleepless nights. Any movement in the inferior extremity gives rise to unbearable pain.
- Regional Glands:** Are almost invariably involved. They show an enlargement with tenderness and warmth over the region

**General Reaction:** During the first week patient shows a febrile reaction with mild toxæmia.

**Causative Organisms** are the bacillus fusiformis and spirochaetae of the Vincent type. Superficial layers of slough contain only the B fusiformis. The deeper layers and the margins of the ulcer at the junction of the floor show spirochaetae. During treatment, the spirochaetae disappear first. Of the 30 cases all except two showed both the organisms. The spirochaetae were not seen in the two cases. Some of the cases showed other infective organisms also—strepto, staphylo and gram negative cocci.

When the ulcer was washed with sterile saline, and the serous discharge as it oozed from its margins and the floor was sucked by a capillary tube and examined by dark ground illumination, spirochaetae actively motile and in large numbers were revealed (3 cases). A smear of it with gram's stain revealed the bacillus fusiformis also.



Fig. 47

Perforating Ulcers-Leprotic.



Fig. 48

Gummatous Ulcers.

(For Differentiation.)

Smears taken from the tissue fluid sucked by a syringe and a needle from the ulcer margin passing through intact surrounding tissue did not reveal L.D. bodies (2 cases).

Attempts have been made to culture these organisms by a special Technique. With great difficulty one culture could be made out of five cases attempted. Sub-cultures are very difficult to obtain due to other saprophytic organisms predominating and killing the Vincent's organisms.

### BIOPSY:

Biopsy from the ulcer margin shows the fusiform bacillus and the spirochæta Vincenti in the early cases only. Biopsy was done on four cases. In two the report read, "Chronic granulation tissue." In one the fusiform bacillus only was seen in the subcutaneous tissue. In the fourth both the organisms were seen.

### EXAMINATION OF BLOOD:

(1) Blood showed leucocytosis. It is very high in the early part of the disease and is about 10,000 per cmm. of blood during the later stages. In the early stages there is polymorphonuclear predominance and in the later stages relative lymphocytosis up to 40 per cent.

(2) Usually there is anæmia of hypochromic microcytic type.

(3) Blood wasserman reaction is invariably negative. Out of 25 cases whose blood was examined 24 were negative. One was positive strong. But his smears showed on D.G. examination Vincent's spirochaetae and the fusiform bacilli.

### TREATMENT:

Various methods of treatment are in vogue. The general principle is to remove the sloughs from the base and give a protective dressing. I have tried the following methods advocated by James with slight modification:—

A liquid is prepared in the following proportion:—

Copper sulphate	... 1 oz.
Glycerine	... 2 oz.
Acid carbolic	... 1 dr. to an ounce of the resulting solution.

The ulcer is gently cleared with wool swabs, the limb placed horizontally and the solution is applied in a piece of wool of the size of a pea, the application being continued for about two or three minutes. Then a dressing of acriflavine 1 in 10,000 on gauze is applied. This is repeated once daily. Most ulcers were clean by the fourth or fifth day. Later 1% acriflavine ointment to protect the granulation and scarlet red ointment for the edges of the ulcer were given. The limb was strapped with sticking plaster and dressings repeated once in three or four days. The average duration for a case to heal is 6 to 8 weeks.

Table VIII.

Cases treated on James's Method:—

S. No.	No. of days in which organisms disappeared.	Wound healed in No. of days.
1	3	16
2	3	11
3	3	6
4	3	6
5	..	40*
6	...	20*
7	7	60*
8	2	5
9	3	...
10	2	4

\*Extensive ulceration — more than 2" in diameter. In one the subjacent periosteum was involved.

Some cases were dressed with 1% aqueous solution of Gentian Violet after the sloughs were removed and the results were equally good.

When the ulcer is small and not more than 1" in diameter it epithelialises well; otherwise, skin grafting has to be done after the sloughs are removed and the ulcer gets clear with the appearance of healthy granulation tissue.

When the ulcer is over a bony surface the scar that follows is very weak and may lead to secondary breakdown with the least trauma. So whole thickness skin graft in these situations has been advocated.

Cibazol powder by itself is effective in controlling the infection. However, it does not so

effectively and so quickly remove the slough as copper sulphate. Cibazol is not at all painful whereas copper sulphate caused much discomfort during and for nearly half an hour after the cleansing of the ulcer. The total time for the ulcer to heal is more or less the same in both the cases.

### PENICILLIN:

Penicillin has been tried only on a limited number of cases. It is instilled locally in 1 in 2,000 dilution. The slough is removed gently and mechanically and then the drug applied once a day. The pain disappears within half of an hour dramatically. The patient spends a very restful night after the first instillation itself. However the pain reappears the next day. But in three or four days it disappears once for all. The smears get clear of the organisms in 3 to 5 days. The wound rapidly epithelialises. The time taken to heal is very short—being only 8—18 days. The total dosage also does not exceed 10,000 to 15,000 units.

If penicillin can be made available in sufficiently large quantities for use in the outpatient department it can reduce the number of chronic cases that come for dressing day in and day out, and also, incidentally, the consumption of gauze and cotton used for dressings.

### (b) FUNGUS INFECTIONS

The infections usually start in the webs of the toes or in the edges of the nails. The first clinical symptom is itching especially when the lesions are moist. After the itching a small vesicle is formed. In most cases it gets inflamed and becomes a pustule containing a yellow fluid. When these vesicles are scraped and the fluid examined microscopically the fungus can easily be identified. Sometimes as a result of infection lymphangitis may develop. This causes denudation of superficial epithelium with spreading edges and several vesicles are found round one vesicle or they may spread in a line or circularly. The treatment of this is dressing with one per cent. aqueous Gentian Violet. These conditions are sometimes so resistant to any type of treatment adopted that only deep X-ray gives satisfactory results.

"Miss G. A. H.F. 16 years, admitted for the treatment of painful condition of the 3, 4, 5 toes. Patient developed a small vesicle on the inner aspect of the fifth toe of the left foot, three days before admission. It was painful, with itchy feeling all round. Then a number of them appeared one after another on the same surface of the fifth toe, on the abutting surface of the 4th and on the inner aspect of the foot. The outer aspect of the dorsum of the foot and the fourth and fifth toes showed swelling and lymphatic oedema. The popliteal and the inguinal glands were enlarged, painful and tender. The general condition was fair. Temperature 99° F. and P. 92 per min.

The vesicles were touched with 1% aqueous gentian violet, ichthyol in glycerine painted over the dorsum of the foot and streptocide given gm. 1 thrice daily for three days. The swelling came down, and the vesicles disappeared. She was all right in 15 days.

The various cracks and fissures noted in the foot around the margins of the heel and the sole are one type of manifestation of ringworm. This is met with in almost 60 to 80 per cent. of the working class of people. The fissure once formed is difficult to close up and heal as repeated pressure on the sole during locomotion opens their mouths. Due to the bare condition of the feet and the contact with moisture in the working class the possibility of secondary infection is very great. Infection thus superimposed may be localised or may spread causing severe reaction.

The treatment of these cases is continued rest, protection from moisture and application of fungicides like Whitfield ointment.

Ringworm infection may involve the nail which becomes discoloured and brittle. The nail should be trimmed and fungicides applied.

The other important variety of fungus infection of the foot is *Mycetoma Maduræ*.

### (c) MYCETOMA MADURÆ

This is a chronic inflammatory disease of the foot caused by a fungus of the *Maduremyces* group. The foot gets swollen with pro-

gressive degeneration of the deep structures. The surface of the skin shows granulomatous nodules and the whole foot is riddled with sinuses. Those sinuses lead down to the diseased tissues in the depths of the foot. From the sinuses exudes an oily discharge containing small rounded granules. These granules are of different colours, black, white, yellow or red, one variety being present in one case.

The fungus can be demonstrated on squeezing the granules on to a microscope slide and examining it under the microscope. The mycelium will be seen as a fine net work with numerous branches, with radiating threads ending in prominent club shaped terminations like a ray fish; hence the name ray fungus.

The fungus gains entrance into the deeper tissues through a thorn prick or a scratch in the sole of the foot. The early lesion is a localised nodule of dense fibrous tissue containing the grains of the fungus. From this encapsuled nodule sinuses radiate burrowing into the tissues. Some may reach the surface on the dorsum of the foot or in the sole with nodular elevations with fine tracks within. As they burrow deep they do not respect muscle tendon, or bone, and disorganise and destroy all tissues. These sinuses may communicate with one another. The inflammatory reaction leads to fibrous tissue formation around the sinus tracts.



Fig. 50

Madurac Foot.



Fig. 49

Madurac Foot.



Fig. 51

Madurac Foot.

Regional lymphadenitis in the groin is common. Secondary septic infections may occur, but the disease does not often kill directly; eventually, the patient dies of some inter-current infection. The progress is very slow.

**Treatment:** In the early stages complete excision of the involved tissue with a diathermy knife is sufficient. But as is generally seen the cases never come to the hospital before the bones are also invaded; and at this stage amputation is the only recourse left.

"V.S. 40 years H.M. Ryot admitted for the treatment of a swelling of the left foot. The trouble started three years earlier as a small ulcer in the left foot just below the lateral malleolus; swelling followed and gradually reached the present condition, involving the outer and upper portions of the foot. Patient said that through the many openings on the surface of the foot sago grain like structures pass out in the 'pus'.

Examination revealed diffuse swelling of the left foot, both borders and the dorsum. The sole also was involved in the proximal half. Characteristic tubercles with sinuses at the summit of each, exuding seropus mixed with sago grain like bodies were present all over the swelling. The toes and the ankle region were free. Swelling was slightly warm to touch and hard to feel. Ankle movements free. Mid-tarsal movements painful and restricted. The general condition of the patient was good.

One of the granules from the wound was crushed on a microscope slide and stained and examined. *Actinomyces madurae* was identified.

An X-ray of the foot revealed circular areas of rarefaction and obliteration of joint space with decalcification suggestive of actinomycotic changes in the left tarsal and metatarsal regions."

**Treatment:** Amputation at the seat of election was done under spinal anaesthesia. Patient made an uneventful recovery.

The pathological report on the specimen sent after amputation was 'section shows mycetoma *madurae*.'

#### (d) CORNS AND CALLOSITIES

Corns develop on the foot as a result of prolonged pressure—generally from ill-fitting shoes. They are usually found over the dorsum of the toes, and at the base of the metatarsals of the great and little toes. They are acutely painful and recur if not excised completely down to the core exposing the blood vessel at the root. Change of shoe to one with a broad toe only gives temporary relief.

Callosities form on the under-surface of the heel and the plantar aspect of the foot over the head of the first metatarsal. They are very painful. Effective cure is diathermy excision of the callosity. Relief can be obtained by taking the weight off the painful area by cutting in the sole of the shoe or the sandal conforming to the shape of the callosity.

#### (e) INFECTED BURSAE & CYSTS

The bursae that develop in the foot are always adventitious. Their development is always due to repeated trauma incident to the particular occupation. Bursae may develop over the head of the first metatarsal in hallux valgus (bunion) or over the tarsus in club foot.

**Traumatic bursitis:** Usually results from excessive friction and pressure. Serous fluid soon distends the bursa. Very severe pain will be present. But the process is generally chronic in this variety of bursitis. The synovial lining membrane gradually gets thickened with collection of serous fluid inside. If this continues without subsidence or repeats itself, the bursa becomes very thick with formation of adhesions inside.

**Acute Infective Bursitis** frequently follows abrasions and wounds. It may be a secondary feature in cellulitis and lymphangitis.

**Treatment:** If the infection does not subside completely and the condition causes continued pain and disability the entire bursa is dissected out and enucleated. If the symptoms are acute and there is effusion inside the bursa it should be incised to relieve tension. When the symptoms subside and infection is controlled the bursa should be removed entirely.

#### Infected cysts:

There were two cases admitted with a cystic swelling in the dorsum of the foot antero inferior to the tip of the lateral



Fig. 52



Fig. 53

#### INFECTED CYSTS

malleolus. One was of two months' and the other six months' duration. Both cases were painful causing discomfort.

They were enucleated entire. The pathological report on one of them was 'sebaceous ayst.' The other was reported on as a cyst containing hyaline material with no evidence of inflammation.

#### (f) INGROWING TOE NAIL.

Ingrowing toe nail is not a rare condition. It is seen only in the great toe more frequently at the medial edge of the nail. It may involve both the nail borders and may also be bilateral. This condition may be produced by a congenital malformation but is finally determined by faulty trimming of the affected nail in persons who habitually wear narrow shoes. Even though a large majority of our people do not wear shoes it occurs in a fairly good number of them. Faulty trimming of the nail leads to a possibility of dirt getting in between it and the eplonychium, facilitated by their walking barefooted on the road side. This may lead on to ulceration or paronychia or even onychia



Fig. 54

Ingrowing Toe Nail



Fig. 55

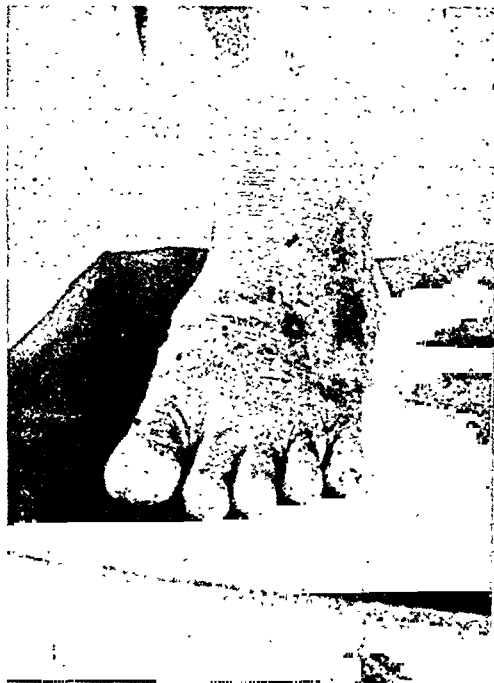


Fig. 56

Guinea-worm Cellulitis.



Fig. 57

(Before Treatment)

CHRONIC INFECTION SECOND TOE.

with subsequent loss of the nail. Often the infection may become chronic and lead on to osteomyelitis of the unguis phalanx.

Treatment consists of excising the margin of the nail with its bed—or removal of the whole nail if both the edges of it are involved.

#### (g) ARTHRITIS.

Arthritis may be acute or chronic. Acute arthritis may be secondary to some systemic infection, the infective organism circulating in the blood and settling down in one of the joints; the ankle joint is rarely involved.

Chronic arthritis is usually tubercular in nature. The mid-tarsal joint is the one usually involved. It is mostly secondary to extension from chronic tubercular tenosynovitis of the tendons in the neighbourhood. The cases come usually late after the disease manifests itself and elective amputation becomes necessary.

#### (h) AINHUM.

This is a disease of the tropics affecting the fifth toe. A groove forms at the digitoplastic fold and deepens until the toe finally drops off.



Nothing is determined as to the aetiology. There is endarteritis with proliferation of the epidermis. The condition passes off unnoticed till the groove of separation begins to ulcerate. When pain develops it is of severe intensity. As the groove of separation deepens the terminal portion gets rounded, cold and hard. With the development of pain treatment is to snip off the toe and shorten the process of prolonged painful separation. The wound heals rapidly.

(i) **Guinea worm disease:** Guinea worm infection is endemic in many parts of India. After infesting the human body, the adult female worm works its way through the subcutaneous tissues and brings out its head through that part of the skin that is in constant contact with moisture usually the dorsum of the foot. The emergence of the head is made possible by local necrosis of tissue caused by

a helminthic poison. At this time the patient may complain of vasomotor disturbances as giddiness and vomiting. Septic infection of the necrotic tissue is very common resulting in cellulitis and abscesses. If the worm dies in the tissues it undergoes calcification giving rise to late sequelae.

**Treatment:** Removal of the worm by daily traction. Surgical excision is ideal. The entire length of the worm with or without the tissue-bed can be easily removed. Cellulitis has to be treated on general lines.

### SUMMARY.

1. An anatomical and experimental study has been made of the fascial spaces and tendon sheaths of the foot; the methods of study have been indicated and the findings described in detail.
2. The common infections of the foot occurring in South India have been discussed in some detail; the aetiological factors have been considered and the importance of the habit of walking bare-foot in the causation of these infection has been stressed. The treatment of each condition is indicated and clinical notes of illustrative cases appended.

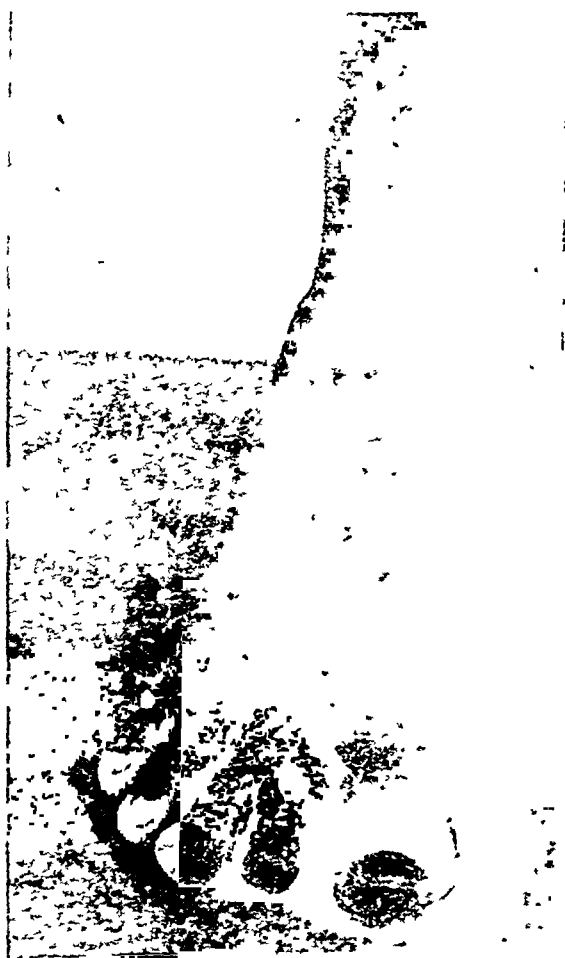


Fig. 58

(After Treatment)



Fig. 59

Osteomyelitis Great Toe.

## REPORTS OF CASES

1. ACUTE SPREADING INFECTION OF THE  
LEFT FOOT WITH SEVERE GENERAL  
REACTION:

(Treated with Penicillin).

K, 34 years, H.M., admitted for painful swelling of the left foot and leg. History of a thorn prick in the heel two weeks before admission. The thorn was removed and later the patient developed a painful swelling round the site of the original prick. The wound was explored by a local doctor, with no relief. The patient came to us with high fever, toxæmia and severe painful swelling of the foot and the leg.

Under general anaesthesia an incision and a counter incision were made over the margins of the heel and drainage instituted. No pus was struck. This did not improve his general condition. Thinking that drainage was imperfect the incisions were enlarged. This time also pus was not struck. The patient was put on cibazol (3 grms. per day) and Soluseptacine 5 cc. 10% solution intra-

venously once a day. For a week the patient was on this treatment by which time he had 21 gms. of cibazol by mouth and 3 gms. of Soluseptacine intravenously. The temperature and pulse rate were still high and the general condition had not improved.

Blood sent for culture was returned negative for infective organisms. A swab from the wound on culture grew staphylococci. The patient was started on penicillin by the intramuscular route in 15,000 units a dose once in 3 hours. The temperature came down by the third day after the penicillin was started and it remained normal from that day. The patient had a total of 480,000 units of penicillin. The local condition also rapidly improved and the patient was discharged 12 days after starting penicillin and 19 days after the date of admission.

This case which was sulpha resistant reacted very well to penicillin.

## (2) GAS GANGRENE FOOT (RIGHT)

B. 25 years, H.M. Fisherman. History of gunshot injury to the right fore foot, 48 hours

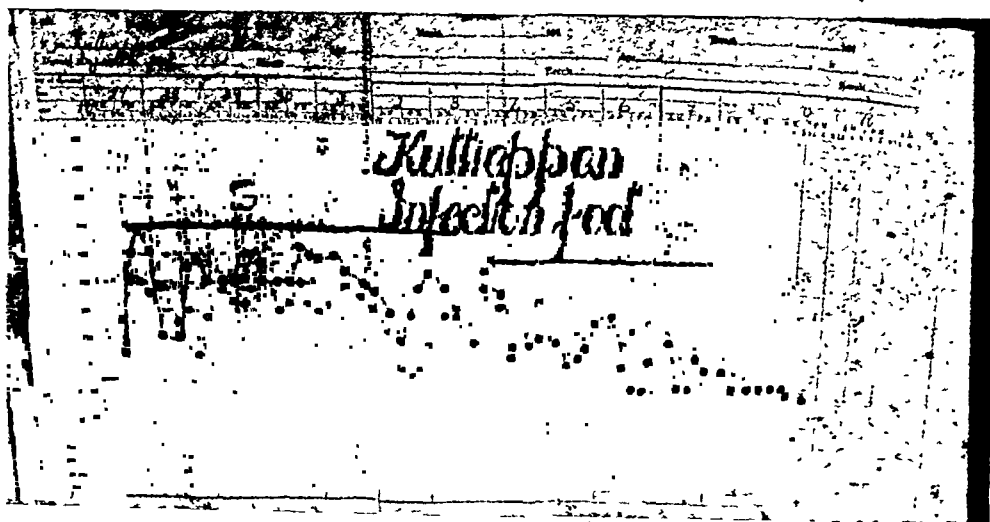


Fig. 60

Case I. Temperature and Pulse Chart of Case I.

Dark Spots—Temperature.

Light ones—Pulse.

Period for she was on Sulpha Drugs.

" " Penicillin.

before admission. The whole of the fore foot was shattered, dark and brownish in colour with loss of sensation distal to the base of the metatarsals, and evidences of gas formation. He had fever with rigour on the night before admission. General condition was fair and the patient was slightly toxic.

X-ray of the foot no bony structure visualised anterior to the talus.

Bacteriological report on the smears sent read "spore bearing bacilli seen in the smears."

Immediately on admission A.G.G. serum 4,000 units and A.T. serum 2,000 units were given. Operation under general anaesthesia—"commencing gas gangrene. At first partial removal was thought of. But later a modified Chopart's amputation was done. The wound was freely plastered with streptocide and closed in layers with two side drains." General condition attended to with glucose saline and plenty of fluids. On the third day the drainage tubes were removed.

On the 8th day the sutures were removed and limb put in plaster.

The wound healed well and patient was discharged two months later. He has been regularly observed at frequent intervals for the last three years. He has now a stable stump and goes about his fishing as usual with absolutely no disadvantage. Fig. 59.

The graft has taken fairly well and the patient is still under observation.

### (3) WEB INFECTION FOOT

G. H.M. 50 years. Admitted for pain and swelling of the left foot. The patient gives a history of injury to the left little toe due to stepping on sharp pointed charcoal two weeks before the date of admission. It bled a little and according to him the wound healed in three or four days. Ten days ago, he found swelling of the foot with pain in the little toe. The swelling in the foot has increased since then. Now the whole foot is throbbing with pain. He complains of pain in the groin also.

The general condition of the patient is good. The left foot was swollen, being mark-

ed in the dorsal aspect. The swelling looks tense and slightly pits on pressure; tender all over. There is a fluctuant area, in the region of the web between the fourth and fifth toes; the skin over the region is white and sodden. Regional inguinal glands enlarged and tender.

A diagnosis of web infection and abscess formation was made and the abscess incised and drained. On the third day, the drainage tube was removed. The swelling in the dorsum of the foot has come down completely. The wound was regularly dressed with steptocide. It healed in 10 days and the patient was discharged cured.

A smear of the pus showed staphylococci

### 7. CHRONIC INFECTION SECOND TOE (RIGHT).

C.V. H.M. 11 years. Admitted for the treatment of an ulcer on the right second toe.

History of illness:—While going to school patient stubbed his toe on a stone and injured it. The wound did not heal and began to spread. There was severe pain leading to sleeplessness. General condition on admission was good.

Local condition:—A big ulcer over the terminal portion of the second toe right foot. The whole of the distal portion of the toe is swollen. Shape circular. Margins of the ulcer were sloping. Floor covered with ash grey pus; very pale granulation tissue. Base indurated and slight bluish appearance of the skin around. Movements at the metatarso-phalangeal joint are free. No appreciable interphalangeal movements due to swelling. Remnants of the nail with its proximal attachment visible. Regional glands not enlarged.

Urine acidic:—Albumin and sugar nil.

Blood:—W.R. negative.

X-ray:—Shows rarefaction of the terminal phalanx.

Bacteriological report:—Smear from the ulcer—a gram negative bacillus and borrelia (spirochaete) resembling Vincent's Organisms seen.

Pathological Report:—Biopsy—chronic inflammatory granulation tissue.

The wound was dressed with streptocide every day for a fortnight but it showed no improvement. So partial amputation of the toe removing the diaphysis of the terminal phalanx was done under general anaesthesia. Wound etherised freely plastered with streptocide and sutured with a drain.

The stitches were removed on the 7th day. The wound did not heal well and still showed the same organisms in the smear.

From the 10th day the wound was daily dressed with copper sulphate 1 in 200 solution. In 10 days the organisms disappeared from the wound. The wound was dressed with streptocide later and was healed in another 15 days.

This was one of the early cases in which infection with bacillus fusiformis and Vincent's spirochaete were encountered. Hence James' method of treatment was not tried and the progress was slow.

## OSTEOMYELITES OF THE GREAT TOE (LEFT).

### IN A DIABETIC.

S. H.M., 49 years. Sanitary Inspector, was admitted for the treatment of a discharging wound in the left foot in September, 1943.

**Previous History:**—Diabetic. In 1937 had the left index finger disarticulated at the metacarpo-phalangeal joint. Linear scars showing evidences of infection of fore arm and dorsum of the hand present.

In 1941—carbuncles—a crop of them all operated on,—mainly over the back, on arms and either leg also. Was in hospital for over a month.

During October, 1942, 11 months back, developed acute pain in the left great toe while cycling and had to abandon the vehicle at once. The following morning he noticed two openings one on either side of the nail in the margins of the great toe. They were exuding thin pus. 10 days later, the openings enlarged and communicated with each other across the anterior margins of the great toe distal to the distal margin of the nail. 2 or 3 small bits of bone were removed from this wound in a local hospital and the wound healed in about two months. He had no more

pain and he was able to cycle and discharge his normal duties.

**History of present illness:**—2 months and 15 days back he noticed a small opening in the medial margin of the great toe exuding thin fluid. He was dressing it with spirit gauze and going on his duty as usual. Since one month there has been pain and swelling of the foot. Swelling had involved the leg also since 20 days. Unable to cycle or even walk. He said that his urine was free from sugar, when last examined earlier than October, 1942. He examined it again one month back and found that sugar was present in plenty.

**Condition on admission:**—Elderly individual about 50 years of age—teeth—a few missing, remaining teeth dirty, tartar coated. No pyorrhoea alveolaris. Tongue moist, clean. No fever. Pulse 86 per minute; good volume and tension. Brachials show evidences of arteriosclerosis. Cardiovascular and respiratory systems—nil abnormal.

### Local condition:

1. The whole of the left leg below the knee and the dorsum of the foot and also the balls of the great and second toes in the sole were swollen. Swelling in the dorsum was more marked along the medial border, extending beyond and behind the medial malleolus. Great toe was swollen to twice the size of the sound one and had a sodden appearance.

2. One big ulcer  $1\frac{1}{2} \times 1$  over the dorsum of the foot at the proximity of the web between great and second toes. Pale granulation tissue. Bluish discoloration around the margins of the ulcer. Slight oozing of serous fluid. This ulcer is of 10 days' duration and is slowly spreading.

3. Another chronic indolent ulcer on the inner margin of the great toe discharging seropus.

4. The nail of the great toe is all shrivelled up, thin and soft.

5. Distally a groove showing the healed cross connection between the ulcer on the medial margin of the great toe and one which now is healed and located previously on the outer margin of the toe.

6. An ovoid ulcer with sprouting granulation tissue in three places distal to the ulcer men-

tioned under 3. On probing small bits of bone felt underneath.

7. Another small opening covered by a scab—distal and inferior to the one described previously under 6.

8. Inflammatory swelling of the medial margin of the foot involving the adjoining dorsal part of the foot, oedematous and tender on pressure. Swelling is spreading below and behind the medial malleolus.

9. Another small area, ovoid  $\frac{3}{4}$ " x  $\frac{1}{2}$ " over the dorsum of the foot in the lateral margin at the site of the base of the fifth metatarsal. Painful, tender on pressure. Soft no pitting on pressure.

10. Loss of sensation to pin prick below the level of the malleoli on the dorsum of the foot, along the lateral border and to about 1" anterior to the lower border of the medial malleolus on the medial aspect of the foot.

Loss of sensation to touch—cotton wool—below a level of  $\frac{3}{4}$ " above the tips of the malleoli—over the dorsum of the foot and in the borders.

Regional glands — Popliteal and Groin glands are enlarged and tender.

Urine—Reaction acidic. Sugar 3%. Albumin Nil.

Blood—Wasserman negative.

Blood pressure 125/65.

Glucose tolerance test:—

Blood sugar. Fasting 320 mgm. per cent.

$\frac{1}{2}$  hr. after giving 50 gm. of glucose 380 mgm. per cent.

1 hr. after giving 50 gm. of glucose 500 mgm. per cent.

$1\frac{1}{2}$  hr. after giving 50 gm. of glucose 532 mgm. per cent.

2 hrs. after giving 50 gm. of glucose 532 mgm. per cent.

Urine sugar in all specimens.

X-ray revealed necrosis with partial absorption of the bones of the left great toe. All the phalanges involved.

Bacteriological report:—Smear from the sinus on great toe shows streptococci, staphylococci and pus cells.

Treatment:—Eusol baths and dressing. Insulin to control diabetes.

Advised amputation of the great toe. Patient refused operation and was discharged against medical advice.

## 9. ACUTE LYMPHANGITIS.

Miss L. 24 years. Admitted for a painful condition of the foot with an ulcer between the toes. On the night before admission, the patient felt itching sensation in the web between the fourth and the fifth toes of the left foot. She scratched and an ulcer developed over that area with pain shooting all over the foot. She was unable to walk and movements of the foot caused pain at the seat of the ulcer.

The general condition of the patient was good. There was a small ulcer in the web between the fourth and fifth toes with slight swelling all round. The whole area around was red, inflamed, painful and very tender. Red streaks of lymphatics could be seen running up the dorsum of the foot in front of the ankle up to the lower  $\frac{1}{3}$ rd of the leg starting from the site of the ulcer. A smear from the ulcer showed streptococci.

The ulcer was dressed with streptocide. Ichthyol in glycerine was painted over the dorsum of the foot. The ankle and the foot were strapped. Streptocide 1 gm. three times a day was given by mouth for two days. On the third day, the pain came down, the streaks disappeared and the patient was able to go about normally.

## 10. ACUTE LYMPHANGITIS LEFT LEG WITH ABSCESS FORMATION.

P. H.F. 25 years, was admitted for the treatment of painful swelling of the left leg and foot, 20 days' duration. There was no history of injury. The dorsum of the foot and the leg swelled up suddenly with severe pain all over and inability to walk. This subsided in about 8 days, though not completely. 13 days later, the pain and swelling reappeared with inability to walk. This time also she did not give any history of injury.

On admission, the patient was acutely ill, actually in agony with pain. The temperature was 98.8° F. Pulse 98 per min. of moderate volume and tension. Slight evidences of toxæmia present. Examination revealed swelling of the dorsum of the left foot and the lower

two-thirds of the leg. The skin was shining and dark brick red in colour, warm to touch, acutely tender and severely painful. No red lines made out in the leg, due to the dark complexion. Movements of the ankle and midtarsal joints possible though painful. The popliteal and groin glands were palpable, warm and tender.

The limb was freely painted with ichthyol in glycerine, and bandaged. The patient was started on streptocide 3 gms. a day. There was intermittent rise in temperature reaching up to a maximum of 102.4° F. in the evenings. On the fourth day after admission, the patient developed an abscess at the junction of the lower and the middle thirds of the leg. It was incised and drained. On the sixth day, the temperature came down and remained normal afterwards. The swelling of the leg and the dorsum of the foot almost disappeared. The skin was showing wrinkles. On the 12th day, the patient was perfectly normal with no pain or swelling in the foot or leg. She was able to walk slowly. The abscess wound was almost healing. By the 18th day the wound was healed and she was discharged. A smear from the pus showed staphylo and streptococci.

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# INTESTINAL ANTHRAX

Report of a Case

BY

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and

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The rarity of anthrax infection of the human intestine is well established (Topley & Wilson, 1937; Jordon & Burroughs, 1945; Muir, 1941). Very few cases are reported in the literature. But intestinal anthrax involving the colon resulting in peritonitis is so extremely rare that the following case is of special interest.

## REPORT OF CASE.

On March 30, 1946, S, a girl at 10 years, was admitted into the Children's ward of the King George Hospital, Vizagapatam with breathlessness and distension of abdomen of four days' duration. No history of any infection could be elicited from the patient or her relatives. The girl was quite healthy previous to this illness. Four days prior to her admission into the hospital, she complained of pain in the left hypochondrium, and soon after watery diarrhoea commenced. There was no vomiting at any time. No blood had been noticed in any of the motions. Bowels were moving 6—10 times a day. Abdominal pain was not of a very severe nature. Gradually the abdomen became more and more distended, increasing breathlessness supervened and the child became more and more ill. There was a low grade fever throughout. On admission, the patient was acutely ill, pulseless and very dyspnoeic with a respiratory rate of about 40—50 per minute. Signs of toxæmia were very marked. She had clammy extremities, intense thirst and pinched facies. She passed a watery motion after admission. On physical examination, the abdomen was distended and there were signs of free fluid. No rigidity was felt in any place, but there was slight tender-

ness with a feeling of a vague mass on deep palpation in the left hypochondrium. The spleen and liver were not palpable. Nothing abnormal could be made out in the heart and lungs except for an extremely rapid heart rate. The tongue was dry and slightly coated. The total W.B.C. count was 18,000 per c.m.m. with 84% polymorphs, 12% lymphocytes, 2% eosinophils and 2% monocytes. The abdomen was tapped and a pint of thin purulent fluid was withdrawn. Gram's staining of the pus showed Gram-positive organisms which resembled *B. anthracis*. Fluid was taken for culture and other investigations. Examination of the motion showed nothing abnormal. The history and clinical findings, which were not typical of any surgical or medical condition, were rather puzzling. The surgeons were of opinion that the condition might be a subacute peritonitis; but any surgical interference was ruled out owing to the gravity of the patient's general condition. There was no constipation, no vomiting, nor rigidity of the abdominal wall, though the patient was having septic peritonitis.

After tapping the fluid, the child was relieved to some extent and was more quiet. 40,000 units of penicillin was put into the peritoneal cavity through the tapping canula and oral sulphonamides were started along with intravenous glucose-saline drip; but the condition became rapidly worse and the patient died at about 7 p.m. on the same day.

Bacteriological investigations of the material on plate cultures on agar and blood agar showed pure typical Medusa-head colonies of the anthrax bacillus. Fluid cultures in glucose

and Hartley broth showed deposits of the fluffy small cotton-wool type. The organisms were long, non-motile, Gram-positive strepto-bacilli indistinguishable from *B. anthracis*. Intramuscular inoculation into a guinea-pig of 0.5 c.c. of a 24-hour culture of Hartley broth produced death in 48 hours. Anthrax bacilli were found distributed in all the organs and were also present in the heart blood removed at autopsy.

At autopsy (3rd March, 1946), the body was fairly nourished, but the abdomen was distended. There were six ounces of foul smelling, slightly blood stained, turbid fluid in the peritoneal cavity. The intestinal lesion was an irregular area in the descending colon at its junction with the sigmoid, extending all round the lumen, 7 c.m. in length and 1 c.m. in thickness (Fig. I). The wall was raised above the surface. The mucosal folds were very much exaggerated and rounded. There were brownish areas of diffuse submucous hæmorrhages with scattered superficial areas of yellowish slough, varying in size from a pea to

a pin's head. The serous coat showed much more œdema and extensive submucous hæmorrhage, and small areas of opacity due to adherent lymph. The surrounding mucous membrane was not affected and the whole lesion was localised to a small segment of intestine. Glands appeared to be slightly enlarged. Purulent material was adherent to the surface of the mucous membrane over the affected patch. The appearance was quite unlike the superficial serpiginous ulceration and surface necrosis that is found in bacillary dysentery. The spleen (142 g.) was slightly enlarged and perisplenitis was present. Fatty degeneration of the liver (256 g.) was noted. Pleural cavities contained 12 ounces of blood stained fluid. The base of the right lung (198 g.) was congested. The left lung (198 g.) showed extreme congestion and areas of collapse and emphysema. The Brain (1250 g.) was congested. Uterus and tubes were normal. Smears from the intestinal ulcer, spleen and heart blood showed typical, capsulated, Gram-positive bacilli resembling *B. anthracis*.

Histologically, sections of intestine, spleen and liver were stained by hæmatoxylin and

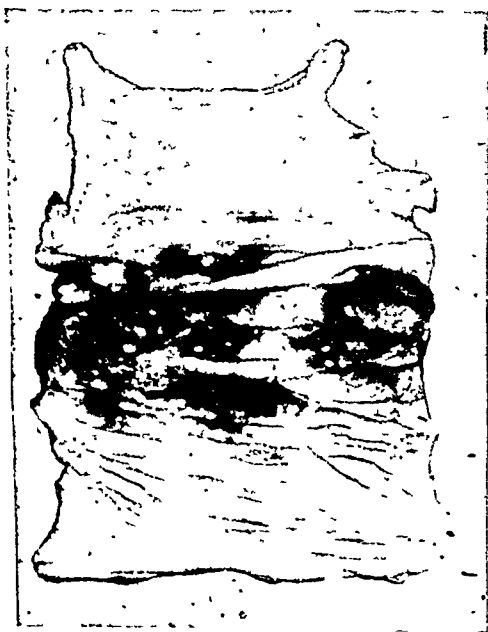


Fig. I

A large haemorrhagic oedematous area in the wall of the colon showing small superficial specks of necrosis.

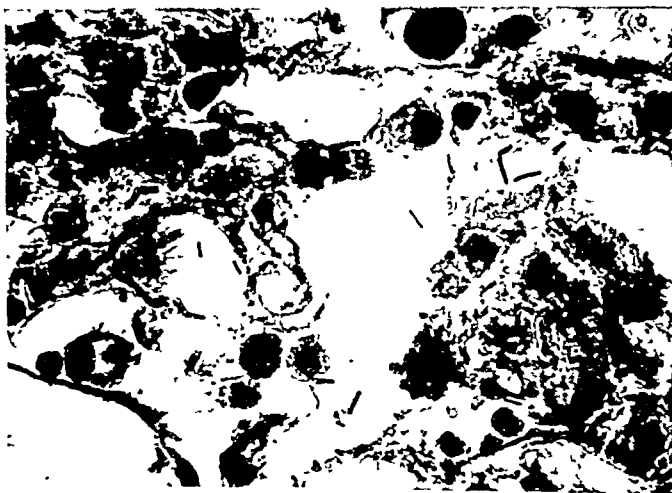


Fig. II

Photomicrograph showing the anthrax bacilli scattered in the inflammatory exudate in the peritoneal coat. MacCallum's modification of Goodpasture's method. (x 700).



eosin and by MacCallum's modification of Goodpasture's method for the demonstration of Gram-positive and Gram-negative bacteria. The section of intestine showed ulceration and necrosis of mucosa. The anthrax bacilli, which were stained blue by the modified Goodpasture's method, were found in large numbers throughout all the coats, but were prominently seen in the sero-muscular coat (Fig. II). A characteristic of the animal lesion is that the bacilli remain confined almost entirely to the blood vessels and are found in maximum numbers in the capillaries of spleen, intestine, liver, etc. and their distribution varies with the animal attacked (Topley & Wilson, 1937). In the present case, however, the lumina of blood vessels were comparatively free. It is possible that the patient might have died before the organisms had proliferated sufficiently to be detected microscopically. This feature has been observed by Stockman (1911) in his studies on pigs and horses. Sections of spleen showed the organisms distributed in large numbers in the pulp, while the sections of liver showed only a few.

The anatomical diagnosis was:—(1) purulent peritonitis due to anthrax infection with 6 ozs. of blood stained, turbid, foul-smelling fluid in the peritoneal cavity; (2) an oedematous haemorrhagic lesion involving the wall of the descending colon, with darkish and haemorrhagic mucosa showing pale yellowish necrotic patches; (3) 12 ounces of blood stained fluid in the pleural cavities; and (4) slight enlargement of the spleen. Death was regarded as due to peritonitis from leakage through the circumscribed intestinal lesion.

#### COMMENT.

The alimentary tract, although the usual route of infection in cattle, is very rarely that in man. A few instances are on record of intestinal anthrax contracted through the medium of spore-infected food. These cases occur among workers with animal material and have probably been due to lack of caution and handling of food with unclean hands. Insufficiently cooked meat from anthrax-infected animals may also be a source of intestinal anthrax. The bacilli are destroyed by the gastric juice, but the spores escape and multiply in the intestine. Experimental evidence, based on the findings in laboratory animals, suggest that for this mode of infection

to occur in man, large numbers of spores must be present in food (Topley & Wilson, 1937). M'Fadyean (1903) has observed that animals dying or just dead may contain the bacilli in their milk; chances of infection by this method is also possible.

It does not seem necessary that all who partake of infected food should suffer from the disease. Senai (1933) reports that in a population of a camp of Kossacks, who ate veal from a calf killed while it was sick with anthrax only one of the participants contracted the disease. By precipitation tests conducted on the members of the tribe, he has shown that consumption of meat infected with *B. anthracis* may also lead to an asymptomatic form of infection. In the present case it could not be elicited whether the patient had taken improperly cooked infected meat or unboiled milk from an infected animal or whether any other members, who partook of the same food contracted the disease. Enquiries through the public health authorities for contacting the parents of the deceased in a village in the Vizagapatam District, have not borne fruit. It is interesting to note that, while the site of infection is usually in the upper part of the small intestine with one or more focal lesions, in the present case it is in the descending colon. The characteristic clinical feature of bloody diarrhoea was not met with. A curious feature in this case was that the bacilli had invaded the serous coat and the peritonium through the necrotic mucous membrane of the colon.

#### SUMMARY.

A case of intestinal anthrax occurring in a young girl of 10 years, causing peritonitis, is described and the pathogenicity of *B. anthracis* for man is discussed.

Our thanks are due to Prof. T. Bhaskara Menon, M.D., D.Sc., F.R.C.P. (Lond.), Major S. Shone, M.D., M.R.C.P., I.M.S., and Prof. N. G. Pandalai, M.D., D.T.M., F.R.C.P. (Edin.) for their kind help in placing the material at our disposal.

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## FOREIGN BODIES IN THE STOMACH

BY

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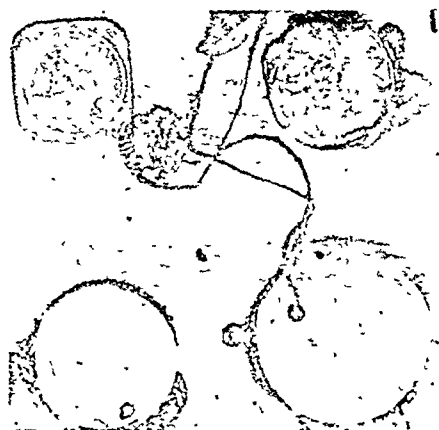
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It has been enunciated as a general rule that foreign bodies which pass through the gullet usually pass through the pyloric sphincter of the stomach and also through other sphincters of the intestinal tract. A variety of foreign bodies in the stomach have been reported in the literature, such as pins, tin tags, tooth plates, coins and hair balls.

The following 4 cases illustrate the types of foreign bodies swallowed. Of these one was a composite mass of lead held together by a string and two were rupee coins and one was a quarter of an anna swallowed accidentally. This last case is reported to show the contrast of the progress of the coins through the pyloric sphincter when compared with those of rupee coins and is not of any academic interest. But the previous three are of sufficient academic interest deserving a report in a journal.

1. In 1936, a male, aged 45 years, a prisoner in a jail was trying to develop a monkey pouch in the cheek by constantly keeping weighty material on one side of the cheek to enable him to hide contraband material. He prepared a discoid type of lead piece along with two two-anna lead pieces to serve as a weight to develop the pouch in the cheek. One day, he accidentally swallowed this weigh and



1. Photograph of the lead pieces removed. They were held together by a piece of string. The pieces were separated and mounted on a plaster of paris slab.

never informed anybody. It passed through the oesophagus without causing any trouble and remained lodged in the stomach. He gradually began to develop colic and jaundice and was admitted into the hospital for this complaint. On clinical examination a diagnosis of obstructive type of jaundice due to gall stones in the common bile duct was made. On X-ray

examination a dense discoid shadow in the pyloric region was seen. At first it was thought to be some metal pieces held outside the body and so a second X-ray examination was made after carefully stripping the patient. The same shadow persisted in the X-rays a second time. So a diagnosis of a foreign body in the stomach was made. On questioning the prisoner he admitted having swallowed the lead pieces by accident. A gastrotomy was done and the foreign bodies which were held together by a piece of string (Fig. 1) were removed. These metal pieces were very heavy, being pieces of lead, of which one was of the

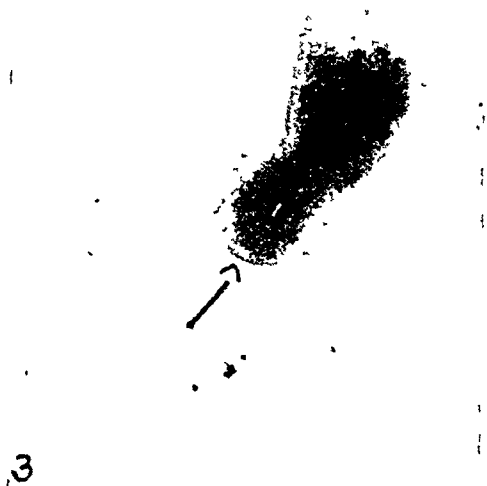
size of a rupee, the other of the size of an eight anna silver piece and the third were two anna lead pieces and were counterfeit coins. By sheer weight in the region of the pyloric canal they must have obstructed the common bile ducts as it passed behind the first part of the Duodenum to gain entrance into the second part of the Duodenum. How far the lead by absorption has been responsible for the production of jaundice is difficult to say. There was, however, evidence to show that the gastric juice had acted on the lead. He made an uneventful recovery and follow up could not be done. Unfortunately his X-ray showing the foreign body is lost, but the foreign body removed has been preserved mounted on a plaster slab in the museum.



2. Radiographic picture showing the rupee coin as it lay in the pyloric antrum of the stomach.



4. Radiographic picture showing the quarter of an anna as it lay in the lower portion of the rectum above the last Houston's Valve.



3. Radiographic picture taken after giving barium meal. Note the dense circular shadow covered by Barium.

2. In 1937, a male was admitted into the hospital for having swallowed a rupee coin by accident—a rupee which he held between the teeth accidentally slipped into his Pharynx and he swallowed it. On X-ray examination, it was found that the rupee coin had got lodged in the pyloric antrum but failed to pass through the pyloric sphincter. As it did not pass through the sphincter even after waiting for two days and as the patient was complaining of pain in the region of the stomach, he was operated on. A gastrotomy was done. An attempt was made to force the coin through the pyloric canal and sphincter but it was found

difficult to do so without damaging the mucous membrane of the sphincter. The rupee was removed and the gastrotomy opening was closed and the patient made an uneventful recovery. On follow up he states that he is keeping very good health (Figs. 2 and 3.).

3. In 1941, a male, aged 35 years, was admitted with a similar history as in the second case. Similar investigations were made, X-rays were taken and the coin was found in the identical position. At operation, similar findings were noted. The patient made an uneventful recovery. On follow up he is found to be in good health.

4. In 1942, a male aged 8 years with a history of having swallowed a quarter anna, was brought. The metal piece not having come out with faecal matter, the mother got anxious and brought the patient to the hospital. Screen examination showed the position of the coin above the last Houston's valve of the

rectum; it was manually removed after taking an X-ray. This case shows that the quarter anna piece easily passes through the pyloric sphincter and is reported to show the harmless consequences of swallowing a quarter of an anna.

#### POINTS OF INTEREST:—

- (1) These 4 cases are reported to illustrate the types of foreign bodies seen in the gastro-intestinal tract.
- (2) The heavy lead pieces caused obstructive symptoms of the common bile duct by sheer weight and caused obstructive type of jaundice.
- (3) The rupee coins in both the cases could not pass through the pyloric sphincter.
- (4) The last case is reported to show by contrast, the easy passage of a quarter anna coin, through the gastro intestinal tract.

## A CASE OF OSTEOCLASTOMA OF THE HEAD OF FIBULA

BY

DR. S. P. SRINIVASTAVA,, M.S., F.R.C.S. (Eng.), AGRA.

O.C., age 35 years, male, was admitted on 1-3-1946 with a painful swelling in the upper third of right leg. Duration:—about one year.

**History:**—The swelling was small in size at first but for the last three or four months has been growing rapidly. It was painful; otherwise there was no discomfort or any disability. The patient was a healthy young man with no history of loss of weight. On examination, the swelling was limited to the upper third of right leg on its outer aspect just below the level of the knee joint. Size of the swelling was about 4" x 3", hard in consistency at places specially in the centre and soft at the periphery. Its outline was diffuse merging into the surrounding tissues. The swelling was tender and slightly hot to touch. There were one or two prominent veins on the surface beneath the skin.

Palpation showed that the swelling was in the head and upper third of the shaft of the fibula.

The knee joint was free and all its movements were normal and painless. The movements of the ankle joint were also normal and there were no signs of involvement of the common peroneal nerve. X-Ray of the swelling showed expansion and destruction of the head and upper third of the shaft of the fibula.

**Operation Notes:**—Operation was done under spinal anaesthesia 10 c.c. of Percain 1 in 1,500 being used.

A vertical incision about 6" long was made on the outer side of the upper third of the leg and the skin flaps reflected. The common peroneal nerve was isolated. The tumour tissue had infiltrated the bellies of the extensor and peroneal groups of muscles in their upper thirds and so they had to be divided at the level of the division of the shaft of fibula. There was slight infiltration of the growth into the bony portion of the lateral condyle of the upper end of the Tibia and the capsule, and during the process of excision, the knee joint was

exposed at one place. The peculiarity of the growth was that it was completely avascular and the excision was altogether bloodless. The wound was closed with a drainage tube kept for 24 hours. The lower limb was kept on a posterior plaster slab with the foot at the right

diagnosis of Osteoclastoma starting in the head of fibula and involving the upper third of shaft. In the skiagram the upper end of the Tibia appeared to be free but exploration showed that this was also involved.

The tumour had extended beyond the confines of the bony wall and invaded the muscles which had, therefore, to be excised.



Skiagram showing expansion and destruction of the head and upper third of the Shaft of the Fibula.

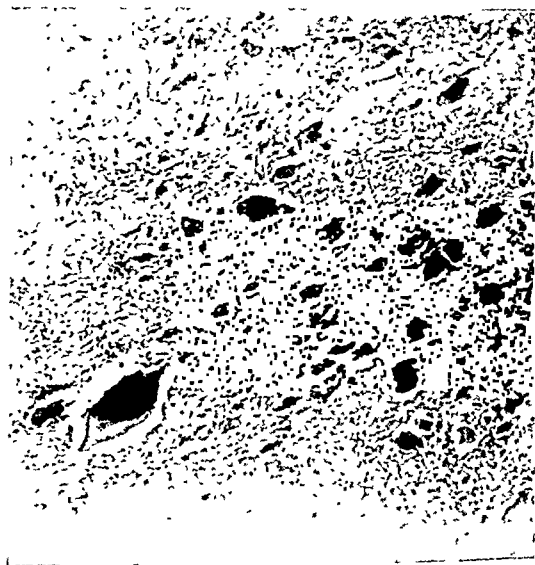
angles to the leg. Healing was by first intention without any limitation of movements of the knee joint. There was foot drop perhaps due to the division of the muscles in their upper third as the nerve trunk was definitely saved except for the division of a few twigs coming in the way.

The patient was given a plaster boot with walking caliper for about 6 weeks as he would not stay in the hospital for faradic massage of muscles or post-operative deep X-Ray therapy.

After removal of the plaster, there was not much improvement in the paralysed muscles. otherwise the patient was perfectly alright without any pain in the leg.

**Pathological report:**—Picture suggestive of Osteoclastoma.

**Discussion:**—The history, clinical picture and skiagram leave us in doubt regarding the



Photomicrograph of section from the tumour.

The knee joint was not involved, the infiltration occurring only up to the articular cartilage of the upper end of the Tibia. Had the patient been operated on earlier, excision of the head alone would have been sufficient for complete cure, but the prognosis now is guarded.

The avascularity of the growth is a significant feature here, very much like the white myeloma, described in the lower end of the radius and unlike the usual picture seen in Osteoclastoma occurring elsewhere. There was complete absence of the bony shell around the growth. The latter was friable and brownish in colour.

I am thankful to Maj.-General H. C. Buckley, I.M.S., Superintendent, for allowing me to publish the case, and to Dr. H. N. Bhatt, F.R.C.S. (Edin.), D.M.R.E., for the skiagram. I am also thankful to Dr. B. N. Wahi, Professor of Pathology for the photomicrograph.

# FACILITIES FOR INDIAN RESEARCH WORKERS IN ENGLAND

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The following has been sent by the Surgeon-General with the Government of Madras, to the Secretary, Association of Surgeons of India, for circulation among its members:—

Copy of D.O. No. 19-2-46-P, & D from the Director-General, Indian Medical Service to Surgeon-General with the Govt. of Madras.

Sub: Facilities for Indian Research Workers in England.

The Indian Research Liaison Committee in London has undertaken to offer advice regarding the laboratories and institutes in the United Kingdom in which facilities for special training in research may be obtained by Indian Medical Graduates and to assist, as far as possible, in placing such workers in suitable institutions.

The Committee considers that, as at present the number of admissions available in the United Kingdom is very limited, full advantage can be taken by India of such admissions only *if applications from this country* are submitted *through a special channel* and if approximate steps are taken to ensure that persons with high academic qualifications and a background of experience giving promise of high performance after training, are alone selected and sent to that country.

The overseas training scheme which has been sponsored by the Government of India in association with Provincial Governments will, it is considered, help to secure that most of the places available in the United Kingdom for training research workers will be reserved for candidates who are selected by the Central Selection Board appointed by the Government of India and, therefore, the Committee's suggestion will, to a great extent, be met. It is at the same time probable that a certain number of medical candidates for studies abroad will attempt to secure admission in the United Kingdom by direct approach in that country. We have been informed that those authorities are particularly anxious that the record of such applicants should be evaluated and that a definite opinion about their suitability should be given by a competent authority in this country. While the Indian Research Liaison Committee has naturally raised the question only about those desiring training in research institutions in the United Kingdom, instances are not frequent of candidates for other types of post-graduate training in medical subjects proceeding from this country to Britain without having secured admission beforehand and of their finding themselves in difficulty after arrival there. In order to minimise the occurrence of such cases I am asked by General Hay to say that he would be grateful if adequate publicity could be given in your province, through medical associations, recognised service associations and medical colleges to the facts set out about and if all intending candidates could be encouraged, to apply through your office and not directly to the institutions concerned in the United Kingdom. Such applications, if they are sent with your recommendations to this office will be fully considered and all available steps will be taken to secure, as far as possible, admission for deserving candidates in suitable institutions.

## ASSOCIATION NOTES

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## The VIII Annual Conference.

The 8th Annual Conference and the General Body Meeting of the Association of Surgeons of India will be held at Lucknow on the 27th December, 1946; the exact time and place of the meeting will be announced later. All members are requested to attend. Members wishing to attend the Conference are requested to get into touch early with the Local Secretary, Rao Bahadur Dr. K. S. Nigam, M.D., F.R.C.S., D.T.M., 8, Shamina Road, Lucknow. The detailed programme, etc., will be circulated later.

On the 27th, the General Body will meet to discuss amendments to Rules, etc. The

General Body will meet again on the 30th to elect the President for the ensuing year. Nominations for the post of the President should be handed over to the Secretary on the 1st day of the Conference, i.e., 27th December.

\* \* \*

## THE LIBRARY.

The Library Account shows a grand total of Rs. 4,007. Further contributions are expected. Donations will be acknowledged in the Journal from time to time.

## SUBJECTS FOR DISCUSSION

## 8th Meeting:

## 1. Carcinoma of the Rectum—

Opener: Dr. C. P. V. Menon, Madras.

Seconder: Dr. E. J. Borges, Tata Memorial Hospital, Bombay.

## 2. Carcinoma of the Cheek—

Opener: Dr. B. M. Joly, Delhi.

Seconder: Dr. K. M. Rai, Madras.

## 3. Hare Lip and Cleft Palate—

Opener: Col. V. R. Mirajkar, Lahore.

Seconder: Rao Bahadur Dr. M. G. Kini, Madras.

## 9th Meeting:

## 1. Bone Tumours—

Opener: Dr. D. R. Meher Homji, Bombay.

Seconder: Rao Bahadur Dr. M. G. Kini, Madras.

## 2. Intracranial Tumour—

Opener: Dr. A. V. Baliga, Bombay.

Seconder: Dr. R. N. Cooper, Bombay.

## 3. Burns—

Opener: Dr. M. R. Munawar Ali, Hyderabad.

Seconder: Dr. G. M. Phadke, Bombay.

10th Meeting:

1. Spinal Tumours—

Opener: Dr. R. G. Ginde, Bombay.

Seconder: Dr. R. N. Cooper, Bombay.

2. Talipes Equinovarus—

Opener: Dr. R. Kalamegham,  
Trichinopoly.

Seconder: Dr. M. Bahadur Khan,  
Hyderabad.

3. Surgical Complications of Typhoid—

Opener: Dr. V. G. Vaishampayan,  
Sholapur.

Seconder: Dr. A. V. Galiga, Bombay.

**PRIZE ESSAY ON**

**"SURGICAL ASPECTS OF AMOEBIASIS"**

The Association of Surgeons of India offers an annual prize of the value of Rs. 150 to the best essay based on original work on 'Surgical Aspects of Amoebiasis.'

The following are the conditions of the award:

1. The competition is open to all qualified medical practitioners registered in India, who have been in practice for not more than 10 years after qualification.

2. The essay should be based on original work and should be written in English.

3. It should be type-written on one side of the paper only and should not contain the name or other indication of the identity of the competitor. Four copies should be submitted.

4. The name, address and qualifications, however, should be written on a separate sheet of paper and enclosed with the essay.

5. The subject is 'Surgical Aspects of Amoebiasis' and the essay should reach the Secretary before the 1st October, 1947.

6. The copyright for the winning essay will remain with the Association of Surgeons of India and will be published in the Indian Journal of Surgery. Other essays will be returned to the senders if accompanied by stamped addressed envelopes.

7. The Governing Body may at its discretion withhold the prize if the essays submitted do not come up to the standard.

8. All communications regarding the above are to be addressed to the Secretary, Association of Surgeons of India, 'Binfield,' Kilpauk, Madras.

C. P. V. MENON,  
Secretary.



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# THE INDIAN JOURNAL OF SURGERY

Vol. IX

MARCH & JUNE 1947

Nos. 1 & 2

## SURGICAL ANATOMY OF THE BILIARY TRACT

By

*A. M. KHAN, Professor of Anatomy, K. G. Medical College, Lucknow.*

And

*R. L. AGARWAL, Lecturer in Anatomy, K. G. Medical College, Lucknow.*

The investigations under report were undertaken with a view to study:

- A. Incidence of anomalies.
- B. Relation of the fundus of the gall bladder to:
  - (i) Tip of the IX costal cartilage.
  - (ii) Subcostal angle.
  - (iii) Linea alba.
  - (iv) Skin surface.
  - (v) Anterior border of the liver.
- C. Proportion between the length of the common bile duct and stature.

### RESUME

Vesalius (1543) was the first to describe the normal relationships of the component structures. Fallopius (1561) emphasized the oblique course of the common duct through the intestinal wall. Glisson (1654) described the occurrence of a sphincteric mechanism around the orifice of the common bile duct and its oblique passage through the tunics of the duodenum. According to him regurgitation of intestinal contents is prevented by "ring like fibres which occupy not only the opening of the duct but also the whole oblique tract." Bidloo was the first to observe the union of the "Ductus Pancreaticus" and the "Meatus Biliaris" within the wall of the duodenum.

Bianchus and Turin (1711-25) postulated the hypothesis that the gall bladder is caused to fill by the contraction of special muscles at the duodenal end of the common duct. Abraham Vater (1729) presented the first description of that "Tubercle" or "Diverticulum" which was later known as the "Ampulla of Vater." Indeed, what Vater described, was not an ampulla but an elevation of the mucosa (Hyrtle).

While Oddi's histological investigations were virtually restricted to animals, his rediscovery of Glisson's sphincter has assumed great importance in clinical medicine. His observations gained credence because he was the first (i) to measure the resistance of this sphincter (ii) to demonstrate that removal of the gall bladder caused a marked dilatation of the bile ducts and (iii) to postulate that dysfunction of the sphincter may explain certain morbid affections of the biliary tract. This prophecy has recently been fulfilled in the recognition of the condition known as "Biliary dyskinesia."

*Material:*—This paper is based on the dissection of eighty-five cadavers in the Department of Anatomy, King George's Medical College, Lucknow. The series includes injected and post-mortem bodies; the latter were pre-

served in 5% formaline during the course of study.

*Method*:—Nine anthropometric observations were made on each cadaver to elucidate dimensions and proportions. The abdomen was then opened and the relation of structures studied in situ. The parts concerned were removed subsequently for detailed study.

The capacity of the gall bladder was also measured on a standard plan. An apparatus was devised; it consists of a funnel, tubing, a curved glass cannula and stand. The funnel was fixed at a height of 42.5 cms. and the capacity measured at a hydrostatic pressure of 50 c.c. of tap water.

### OBSERVATIONS

*Hepatic Ducts*:—The average lengths of the right and left ducts are 0.64 cm. and 0.95 cm. respectively. The right duct is thicker than the left and is in line with the common hepatic duct. Its union with the left is as a rule at an acute angle.

*Anomalies*:—(i) Complete absence in combination with the other parts of the biliary tract.

(ii) Accessory hepatic duct.

Bower observed total absence of the biliary tract in some cases. Unfortunately he does not quote any figures. According to him the

average duration of life in such cases was 70 days. If only hepatic ducts are present and open directly into the duodenum, normal existence is possible.

*Accessory hepatic duct*:—This term is applied to those channels which issue out from the liver and open into the common hepatic duct at any point proximal to the union of the cystic duct. Accessory hepatic ducts were present in two of our cases. Both of them emerged from the right lobe of the liver and drained into the common hepatic duct. Our observations are in harmony with those of Flint who maintains that, "all accessory ducts are right sided."

*Cystic Duct*:—The level at which the cystic duct joins the common hepatic duct varies in different subjects. Its length varies from 0.5 to 4.2 cms. average being 2.21 cms. In two cadavers of the series the lengths were 7 and 8 cms.

*Confluent Anomalies*:—Usually the cystic duct joins the common hepatic duct at an acute angle of 10 to 15 degrees. It may however join in one of the following ways:

(i) Union after winding spirally round.

(ii) Union after running parallel to it for a short distance.

The frequency of modes of union of the cystic and common hepatic ducts is presented below:

TABLE 1

Author	Total No. of cases	Normal angular type		Spiral Type		Parallel Type	
		No. of cases	%	No. of cases	%	No. of cases	%
Ruge	43	14	33	16	38	12	29
Kunze	39	20	51	—	—	19	49
Decomps	50	40	80	4	8	6	12
Eisendrath	100	75	75	8	8	17	17
Present series	85	60	70.6	10	11.7	14	16.4

In the spiral type the cystic duct winds around either in front of or behind the common hepatic duct before joining to form the common bile duct. Thus the cystic duct can describe one quarter, one half, three quarters

or a complete spiral around the hepatic duct. In the present series, out of the 10 instances of the spiral type, anterior union in 6 and posterior union in four subjects were observed.

In the parallel type, the cystic duct ran parallel to the common hepatic duct for a distance varying from 0.5 to 2.0 cms. and then joined it.

In one of the subjects union of the cystic duct was left sided instead of the usual right sided, the neck of the gall bladder lying anterior to the common hepatic duct (Fig. 9).

Cases are on record in which bile entered the gall bladder and was thence carried to the duodenum through the cystic duct. This condition is of importance inasmuch as it supports the hypothesis of Mann that the gall bladder may be but a sampling organ of bile.

#### Numerical Anomalies:—

- (i) Congenital absence of the cystic duct.
- (ii) Cystic hepatic duct.
- (iii) Double cystic duct.

(i) Congenital absence of the cystic duct has been recorded; and in these cases the gall bladder opens directly into the hepatic duct.

(ii) Cystic hepatic duct is present in some cases. This term refers to ducts which may either (a) connect the gall bladder to the hepatic duct in addition to the normal cystic duct or (b) link the gall bladder directly to the liver substance. In the present series two cases were observed; in both there was direct connection between the neck of the gall bladder and the liver.

(iii) Double cystic ducts are present in those cases where there is double gall bladder.

Campche observed a rare abnormality of the cystic duct in the course of a laparotomy: passing anterior to the duodenum it terminated in a malignant mass involving the 1st part of the duodenum. The author accounted for the anteduoanal position of the cystic duct as an anomaly of rotation.

**Common Hepatic Duct:**—The length of this duct varies from 1.0 to 5.2 cms. the average being 2.15 cms.

#### Anomalies:

- (i) Absence of the duct.
- (ii) Dilatation of the duct.

In one subject, there was no common hepatic duct as the cystic duct opened into the junction of the two hepatic ducts. Dilatation of the entire duct system was observed in four subjects; while in one the cystic duct only was dilated. In another case all the ducts and the duodenum were full of round worms. Bower has described two instances of dilated cystic duct in his series.

**Common bile duct:**—The length of the common bile duct varies from 3 to 8 cms., the average being 5.8 cms. The relative lengths of the supra and the retro-duodenal parts could not be recorded due to practical difficulties.

#### Anomalies:

- (i) Very short.
- (ii) Cystic dilatation.
- (iii) Reduplication.

The common bile duct was very small in one subject and there was no supraduodenal part as the cystic duct joined the common hepatic duct behind the duodenum (Fig. 12).

One case each of Cystic dilatation of the bile duct (Choledochus Cyst) has been observed by each of the authors previously. The view current regarding its aetiology may be summarised as under:—

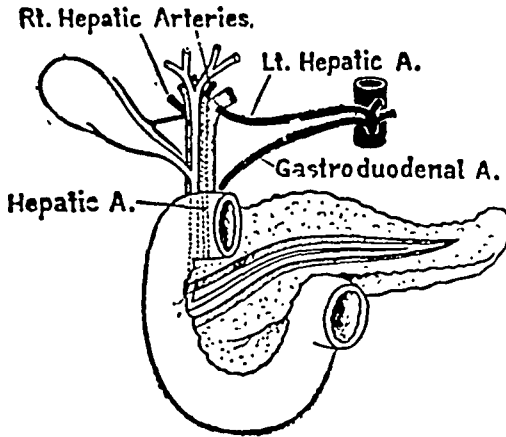
(i) **Embryological:**—According to Boyden it represents a persistence of a dilatation at the upper end of the embryonic choledochus at its original calibre, named as hepatic antrum.

(ii) **Obstructive:**—The presence of a valve at the duodenal papilla and compression stenosis were also thought to be responsible for it; but this view had to be discarded for lack of proof.

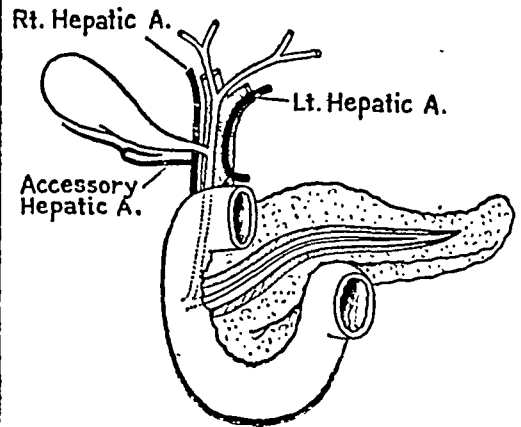
(iii) **Atony:**—The hypothesis of congenital atony of the choledochal wall was suggested but no convincing proof is available.

**Relation at distal end:**—The common duct was always found posterior to the duodenum but its relation to the head of the pancreas was variable. In 55 subjects (65.4%), the duct was lying in a groove on the posterior surface of the head of the pancreas within its fascial capsule. In the rest (34.5%), the duct passed

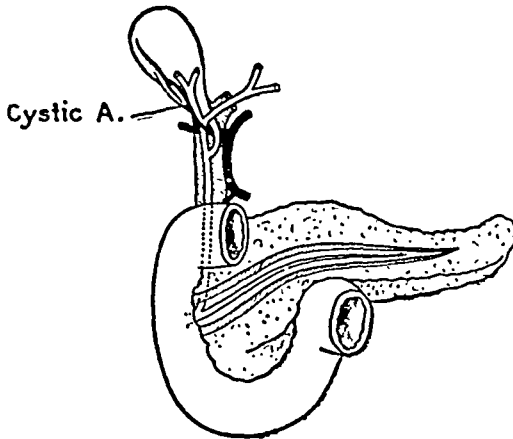
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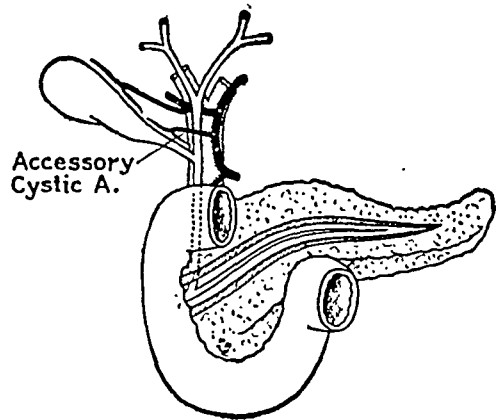
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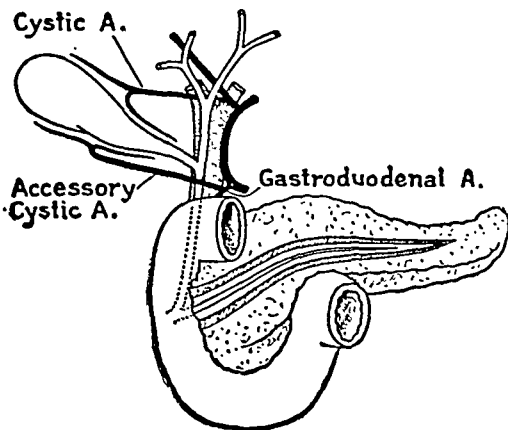
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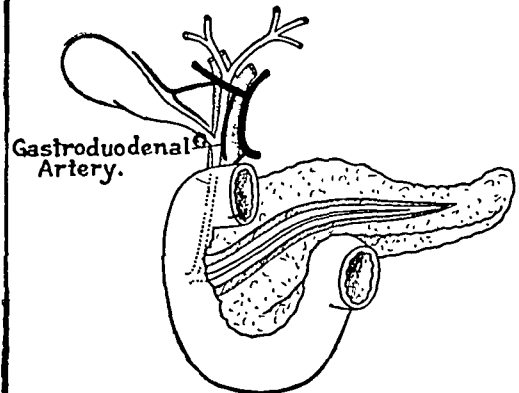
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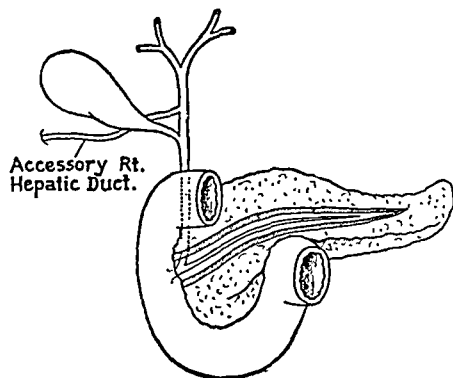


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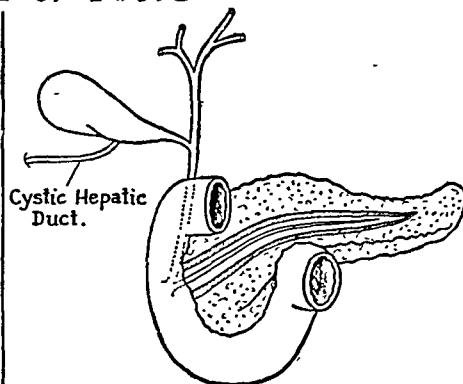


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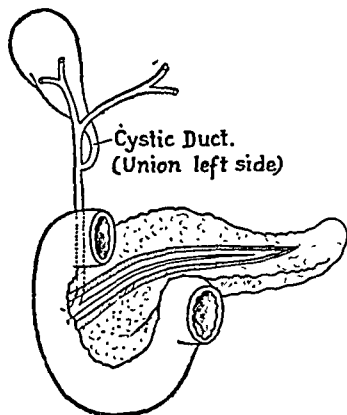
ANOMALIES OF DUCTS



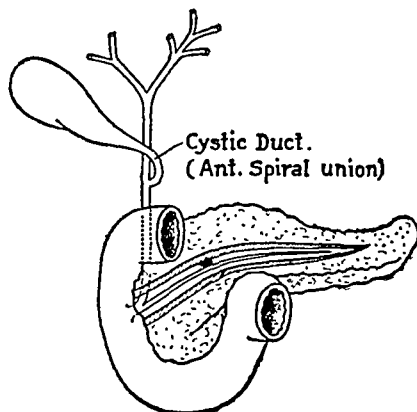
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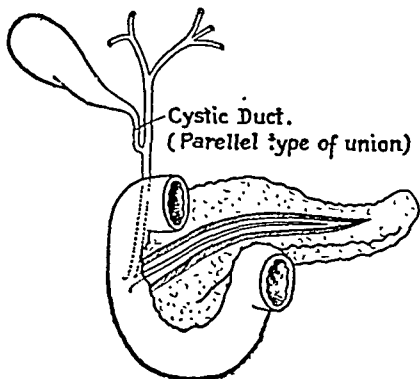
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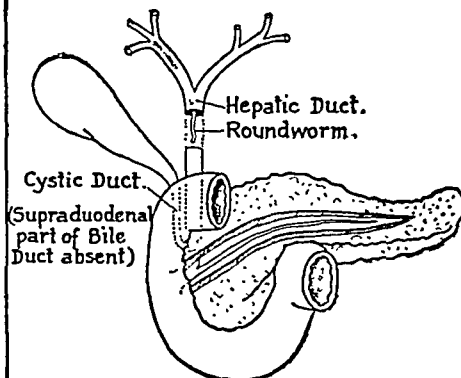
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through the substance of the pancreas before entering the duodenum. Usually the common bile duct is joined by the pancreatic duct within the wall of the duodenum (54.8%), while in 45.2% of subjects union took place in the head of the pancreas.

The lumen of the duct formed by the union of the common bile and the pancreatic ducts is continuous. In some cases, however, it is interrupted by a complete or incomplete septum formed due to the prolongation of the fused walls of the two ducts.

TABLE 2

Observations on the length of Biliary Ducts.

Author	Cystic Duct	Right Hepatic Duct	Left Hepatic Duct	Common Hepatic Duct	Common Bile Duct
Graham and Cole ..	3 cms.	—	—	3 cms.	7 cms.
Present series ..	2.21 cms.	0.84 cms.	0.95 cms.	2.15 cms.	5.8 cms.

### BLOOD VESSELS

#### Hepatic Artery:—

##### Anomalies:

(i) Abnormal origin.

(ii) Accessory Artery.

(i) *Abnormal origin*:—This vessel took origin in one subject from the superior mesenteric artery close to its commencement and attained the free border of the lesser omentum behind the portal vein. It terminated as the right hepatic artery. The left hepatic and the gastroduodenal arteries arose directly from the coeliac axis. (Fig. 1).

(ii) *Accessory Artery*:—An accessory hepatic artery arising directly from the aorta proximal to the superior mesenteric artery was met with once. It was situated on the right side of the common bile duct in its supraduo-

denal course and terminated as the right hepatic artery. A separate left hepatic artery was also present and fulfilled the relationships of the single normal vessel. (Fig 2.)

*Right Hepatic Artery*:—In the present series, the right hepatic artery passed posterior to the common hepatic duct in 50.5% and anterior to it in 12.9%. In 31.7% it lay behind both the hepatic ducts. In 3.5% the vessel passed anterior to these ducts.

#### Cystic Artery:

##### Anomalies:—

(a) Anterior Position.

(b) Accessory Artery.

(c) Abnormal Origin.

(a) *Position*:—The cystic artery was situated posterior to the hepatic duct in 61.1% and anterior to it in 38.29%.

TABLE 3

Author	Artery	Anterior to hepatic duct		Posterior Position	
		No. of bodies	%	No. of bodies	%
Eisendrath ..	Cystic	32	16	168	84
Present series ..	—	30	38.3	52	61.2

## SURGICAL ANATOMY OF THE BILIARY TRACT

It may cross the hepatic duct instead of the common hepatic duct. It was lying anterior to them in 6.5% and posterior in 15%.

(b) *Accessory Cystic Artery*:—It was observed in 5 cases. Its origin could be traced to one of the following sources.

(i) Hepatic.

(ii) Gastroduodenal.

(iii) Right Hepatic.

(iv) Left Hepatic Artery.

(c) *Abnormal Origin*:—This vessel took origin in one subject from the Gastroduodenal Artery. It was lying on the right side of the common bile duct after crossing anterior to it. It sometimes may arise from the hepatic artery.

(To be continued)



# SURGERY OF CANCER OF THE STOMACH

Dr. D. J. JUSSAWALLA, M.S.

(From the Tata Memorial Hospital for Cancer and Allied Diseases)

Modern surgery is under a great debt to the fundamental facts of physiology for its present standing in modern science. There was a time when a knowledge of function of various regions of the body was an accredited study of the physician alone; but the pendulum has swung far back to-day and a physiological understanding of surgical problems is an essential no good surgeon can relegate to the back ground. From a knowledge of function has evolved modern pre and post-operative treatment. Gone are the days of the mere surgical technician, the artist who fashioned in flesh and painted in blood; the days when surgery was yet an art alone. There has now appeared the surgeon-physiologist who pays particular attention to functional activity, not only on the operation table, but also before and after surgery. We endorse Sir William Osler's view that a surgeon should be a physician who operates.

In the surgery of the cancerous stomach this trend is seen very clearly, from the care bestowed by the modern surgeon upon pre and post-operative treatment. Pre-operative treatment aims at establishing as far as possible to normal physiological activity undermined by the new growth. The following account gives in some detail the procedure carried out by us in such cases.

## PRINCIPLES OF PRE-OPERATIVE TREATMENT

### Obstruction:

The commonest site for malignancy in the stomach is the lower third; and, as this is the narrowest part of the viscus, obstruction of more or less extent is caused in most cases. Obstruction produces various metabolic and chemical disturbances; thus dehydration, avitaminosis and anæmia are invariably present. The delay in transit of solids that occurs due to the tumour, leads to a formation of products of altered proteolysis, and also causes a destruction of the vitamins ingested in the

diet. Eventually a state of dehydration is reached on account of insufficient passage of fluids through the obstructed region. When the tumour gets very large, gastric secretion also diminishes with a concurrent loss to the body of its chlorides and acids and various degrees of hypochloræmia and alkalosis occur.

It must, however, be emphasised here that it is in no way essential that hypochlorhydria<sup>1</sup> be present in gastric cancer. In many of our cases a high free and total acidity was present, one case even showing a free acidity of 167 in the fasting juice. The amount of acidity depends on the variety of co-existent gastritis present and the area of mucosal involvement by the cancer. It must also be made quite clear that hypochloræmia can occur in the entire absence of vomiting, merely as a direct result of the toxæmia produced by dehydration. This point has been amply clarified experimentally by Haden and Orr<sup>1(a)</sup> from the Johns Hopkins. In 1939, J. J. Peters<sup>2</sup> writing on metabolic disorders in gastrointestinal diseases, mentioned that the blood sodium level which is diminished in pyloric obstruction, was more significant than the chloride depletion, because sodium concentration does not suffer until a considerable degree of dehydration has occurred. Pre-operative preparation of all our patients has been aimed at correcting these disorders, when present. Intravenous administration of 5 to 10% glucose in sodium chloride has been a routine practice in obstructed cases. Thus the outlook of the "poor risk" patient at the present day is considerably brighter than it was 10 to 15 years back. Usually two infusions of 1000 c.c. each, of a 5 to 10% solution of Dextrose in 0.9% sodium chloride, daily, suffice to correct all these changes within a few days.<sup>3</sup> A careful check is kept on the blood chemistry, as too much NaCl will produce water logging of the tissues leading to a clinically evident œdema of the ankles and hands. Particular care has to be taken of

the older group of cases, where a correct fluid balance and a normal acid-base equilibrium which includes a correct blood chloride level, are of greater importance; otherwise too much strain may be put on the heart and kidneys in sub-clinical cases of incompetency of these organs.

#### **Avitaminosis:**

It has been pointed out by McNealy, Gabler and Taft<sup>4</sup> that the usual diet prescribed for gastric patients lacks in Vitamins B and C whereas the liposoluble Vitamins A and D are in excess. Moreover whatever little Vitamins B and C are ingested get destroyed, due to the delay in transit through the pyloric end. Thompson, Ravdin and Frank<sup>5</sup> have drawn attention to the atony of the gastro-intestinal tract resulting from a deficiency of the entire Vitamin B complex and a further delay is thereby caused in gastric emptying. Thus Vitamin B, particularly Thiamin chloride and Nicotinic acid find their place in the pre-operative care of these patients.

Vitamin C deficiency is known to produce malunion of wounds, which then heal slowly and imperfectly. Lanman and Ingall,<sup>6</sup> and later, Harvey et al.,<sup>7</sup> have conclusively proved that Vitamin C depletion is an important factor in many cases of wound disruption and non-union of intestinal anastomosis. A liberal supply of Vitamin C, is thus of great value in all types of intestinal surgery. As an excess of Vitamin C complex or ascorbic acid is not known to produce any pathological effects, a blood level determination is not quite essential. Vitamin K is given in prothrombin deficiency or hepatic insufficiency, as the liver may then prove inadequate for its role of maintaining normal coagulability of blood, under the strain of a prolonged operation.

#### **Anæmia:**

Patients with a moderate degree of anæmia seem to stand strenuous operative procedures quite satisfactorily contrary to expectations; but with a hæmoglobin content of less than 50% and an R.B.C. count in the region of 2.5 millions, it has always been our practice to give one or two blood transfusions prior to operation. In a few cases, where the blood picture was definitely prohibitive, a corpuscular transfusion from 2-3 intercompatible

donors has given encouraging results and has changed the whole aspect of the case. The distinct advantage of this type of transfusion over the usual whole blood should be quite evident. Not only is the total fluid volume diminished, but concentration of the anti-anæmic constituent of whole blood is very much increased. In the preparation of plasma from whole blood, this corpuscular gel used to be thrown away. Nowadays, whenever indicated, the corpuscles are separated out from the plasma when the blood is quite "fresh" to ensure that no appreciable R.B.C. depletion has occurred. Merely siphoning away the separated plasma and a direct cross-matching of the donor bloods with each other and also with the recipient, is all that is necessary. A gravity drip method at the rate of about 5 c.c. per minute using an 18 gauge needle is entirely successful in giving this anti-anæmic "shock" therapy. No extraordinary reactions have been noted with this method, and the duration of pre-operative treatment is curtailed to the bare minimum.

#### **Plasma Proteins:**

Perhaps in no country in the world to-day a greater lack of nutrition exists than in India. This is particularly true of gastric cases where a plasma protein level of 4 to 5 gms. per 100 c.c. is not at all uncommon. Ravdin and his colleagues have demonstrated, that in hypoproteinæmia, the tissue œdema which is clinically envisaged in the subcutaneous tissues, also involves the gastro-intestinal system and the motility of the whole tract is thereby reduced. He has further shown that the oft-encountered obstruction at the site of anastomosis after operation, is a clinical manifestation of the lack of plasma proteins in circulation. Moreover, the poor healing quality of œdematous tissue is also in part responsible for wound disruption in such cases. Post-operative lung complications are more frequent in these subjects, due to the same cause. Thus, if the blood level of Vitamin B and C is normalised and hypoproteinæmia combated, the important factors concerned in wound dehiscence, obstruction at the stoma and hypostatic pneumonia are eliminated all at once.

Till lately, no eminently satisfactory method of administering proteins directly to the blood

chosen, as better access is gained to the duodenum by this route than with any other. Suturing of the duodenum is one of the most important, if not the most important step in the operation of gastrectomy. More catastrophies occur in this region than in any other. A leakage or bursting of the blind duodenal stump is almost always fatal. In no case did we have a post-operative hernia when this incision was used. It has been said that it weakens the abdominal wall but we have found that in some of our palliative cases who had returned to us with ascitis, dehydration and even proteinæmia the suture line had remained quite intact.

### Technique of Partial Gastrectomy:

Various surgeons the world over, have reported on the dangers of wound sepsis in major abdominal surgery. Frank Lahey of Boston has even evolved a cellophane pad to protect the wound edges from contamination. A careful draping of the operation field and protection of the wound edges has been found eminently satisfactory at our hospital and rarely have wound complications arisen.

It is of the utmost importance to make a careful inspection of the abdomen to note the extent and spread of the cancer. A palpation of the gastro-colic and gastro-hepatic ligaments followed by an examination of the liver and the rest of the abdomen is systematically carried out. The pelvis is examined with special care to rule out Kruckenberg deposits. We have had a few cases referred to us after removal of so called ovarian tumours; where a proper and thorough examination at the initial exploration would have revealed a primary tumour in the stomach, and the patient saved from an unnecessary operation.

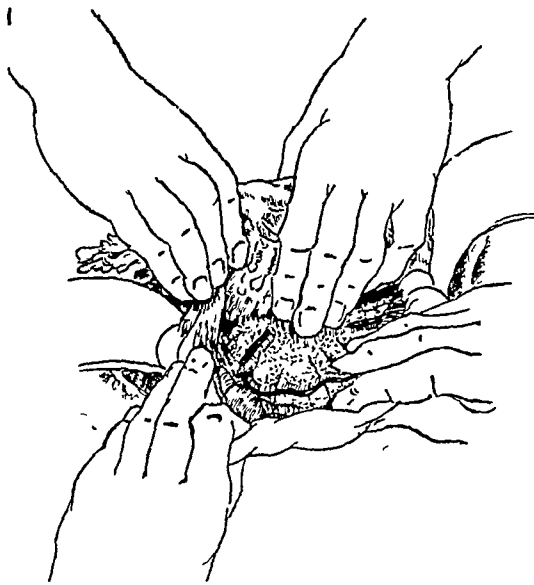
The gastro-colic omentum is next separated from the stomach, taking care to remove all the involved nodes in this region. Unlike as in gastrectomy for peptic ulcer, the gastro-epiploic arteries are removed with the stomach, leaving back very little of the omentum. Ogilvie<sup>9</sup> has suggested a technique for removal of the complete gastro-colic omentum for cancer of the stomach and lately we have been following this method, with excellent results. The great omentum is held up to its

limit by the assistant along with the transverse colon. A sharp knife is used to sever the fusion between omentum and the transverse colon. Very few if any vessels are encountered in this region till the hepatic flexure is reached. With a wet sponge the upper layer of the transverse meso-colon is rubbed off from the colon and mesocolon proper till the ridge of the pancreas is seen. At the extreme right border of the gastro-colic ligament the right gastro-epiploic artery is clearly seen, taking origin from the gastroduodenal. It is clamped at its origin and cut. This leaves the omentum hanging from the greater curvature of the stomach. The stomach with the greater omentum is now pulled sharply to the left, to put tension on the duodenum and facilitate its dissection. The right gastric vessels are found, clamped and cut.

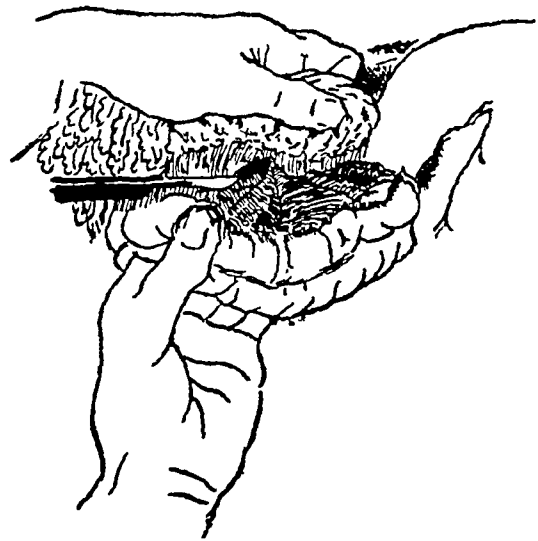
The duodenum is cleaned for a distance of about 5 cm. from the pylorus and a crushing clamp is applied at a suitable spot; a small Payr or Ochsner does very well for this purpose. The proximal end of the duodenum is likewise clamped, and with a carbolic knife, the duodenum is cut in between. Care should be taken to avoid the common bile duct which lies posterior to the first part of the duodenum. It is necessary to catch the pyloric vein as it crosses over the pylorus.

After cutting through the duodenum, the stomach end is carefully wrapped in a wet towel and held in position by a towel-clip. We prefer to close the duodenum with the Parker-Kerr sero-muscular stitch which aseptically invaginates the cut end. This is reinforced by a sero-muscular Lambert suture. All mucosal stitching is done with catgut and the sero-muscular with No. 50 waxed cotton. As this method is aseptic the dangers of peritoneal contamination are minimised.

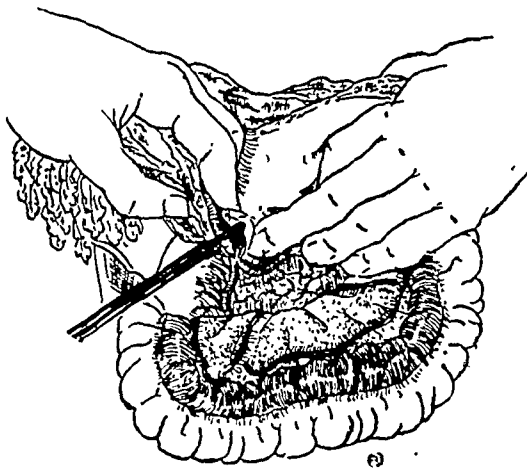
With the stomach held up, the dissection is proceeded with from below, until the left gastric vessels are reached. These are clamped and cut at their origin facilitating removal of all the tissues and nodes lying in that region. This blunt dissection is carried on for at least 5 cm. from the apparent upper limit of the carcinomatous lesion. At the point of section of the stomach all vessels are cut flush with the serosa of the stomach. The



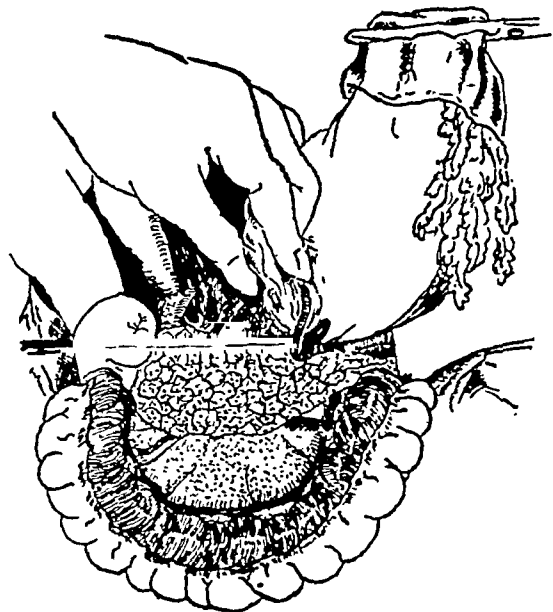
Freeing the omentum and superior leaf of transverse mesocolon from the colon and mesocolon proper.



Opening the fusion plane between the omentum and transverse colon.



Ligation of the right gastro-epiploic artery at its origin.



Exposure of the left gastric artery at its origin from the celiac axis trunk.

left extremity of the greater omentum is now divided between clamps, and the stomach is ready for removal.

In an alternative method used by us till now, the lesser omentum was dealt with by cutting through it to ligate the vessels supplying the stomach till the bundle of the left gastric vessels was reached. This was carefully palpated, silk ligatures were passed around them by means of an aneurysm needle, and the vessels were cut in-between. The greater curvature of the stomach was similarly dealt with but the whole of the omentum was not removed. The present modification, as will be realised, is a distinct advance in the technique of gastrectomy for cancer of the stomach. By this technique, the cancer along with its route of spread, is removed en-mass, according to established rules of cancer surgery.

With the proposed area of section of the stomach thoroughly cleaned, a heavy Payr clamp is applied and the tumour-bearing area finally removed. It sometimes happens that if we are not careful, the terminal portion of the Levine tube passed through the nose prior to the operation gets caught in the Payr clamp. This is avoided by palpating the stomach before putting on the clamps. A loop of the jejunum is brought up in front of the transverse colon and a test approximation with the stomach attempted. In this antecolic method of anastomosis one should always take a long enough loop; about 25 cms. from the ligament of Treitz being the usual length. If by mistake a shorter loop is chosen the transverse colon will come in for its share of post-operative trouble due to the tight band formed by the short jejunal loop. This type of obstruction is particularly liable to occur when the stomach has to be cut high up for a cancer involving the lesser curvature. At the time of suturing, due to the pull exerted on the Payr clamp the anastomosis may appear fairly loose, but once the clamp is let go, the cardia will retract under the costal arch and the jejunum will naturally follow suit, thereby causing tension on the suture line and partially denting the transverse colon.

Whenever there is the slightest suggestion of difficulty in getting the stomach down from under the costal arch, it is much wiser to

keep the Payr clamp on, till the first sero-muscular layer is laid. In this way the Payr may be used as a tractor for the stump of stomach left over. However, if a comfortable approximation can be obtained easily, the Payr clamp is removed after two stay sutures are laid, one at each end between the stomach and the jejunum.

All intestinal anastomosis is performed by us without clamps, with the help of stay sutures alone. One believes in catching all the bleeders at the cut surface before proceeding with the mucosal suturing rather than relying upon intestinal clamps and hæmostatic suturing for stopping the bleeding.

The first layer of sero-muscular continuous stitches is laid, using waxed cotton No. 50 as mentioned before. It is always wiser to start the jejunal suturing very near the mesenteric border so that there will always be sufficient room when the fourth layer comes to be laid. The Payr clamp is now removed if it has been kept on and the crushed edges of the stomach wall are teased open. This will start a fair amount of bleeding. All the bleeders are carefully caught with mosquito clamps and ligated with No. 50 plain cotton. The jejunum is then incised over an area corresponding to the opening in the stomach, and not more than about 1 cm. from the sero-muscular stitching. If a greater space is left in-between, there will arise the possibility of post-operative blockage of the anastomotic opening due to the formation of a valve effect as shown by Wangenstein. The first incision in the jejunum should be made only up to the mucosa, as otherwise a lot of unnecessary bleeding will occur. The mucosal vessels are caught individually between two mosquito clamps and tied. The mucosa is then opened into; the contents aspirated by suction, and the opening finally lengthened to its full limit with the scissors, in-between the two rows of ligated vessels. Any fresh bleeding is carefully checked. The second through and through layer is of chromicised catgut No. 00 on a fused needle. We prefer to start this layer at the mid-point of the openings in the stomach and jejunum. A continuous through and through stitch is laid, till one end is reached. Here the stitch is changed over to a Connell inverting suture with a loop

on the mucosa. This type of suturing is continued as the returning third layer upto the mid-point of the anastomotic area. The suture is now handed over to the assistant who holds it taut. A similar suture is started adjacent to the starting point of the second layer, at the centre of the anastomotic opening. One end of this stitch is tied to the long end left over at the start of the second stitch. The stitching is carried anteriorly using the connell stitch. Where the two anterior stitches meet they are tied together, and the ends cut short. The fourth layer is next laid as a continuous or interrupted sero-muscular suture using No. 50 waxed cotton, to bury the catgut layer. We make it a point to overcarry this layer of stitches at either end and bury the starting and finishing points of the first layer.

By suturing in this manner the corners are well turned in and furthermore as the catgut and cotton layers start and end at different points, the chances of a leakage are minimised. It must be granted that a Connell stitch is not hæmostatic, but as hæmostasis is achieved before starting by ligating the mucosal vessels, more attention is paid to inverting the mucosa; which this type of suturing does very well indeed.

A few technical points may be emphasised. The crushed edges of the stomach must not be cut away after removal of the Payr clamp as this may entail fresh bleeding. Indeed a slight excess of mucosa is conducive to leak-proof suturing. It will also be found that the gastric mucosa will have receded away from the crushed margin. This can be remedied by catching this edge along with the serosal layer in the jaws of the artery forceps used for clamping the bleeding vessels. Another practical point of interest is to see that the suture line in the jejunum is not oblique; for this may lead to torsion and obstruction of the gut as it hangs down from the stomach.

It will be noticed that we prefer to make use of the whole gastric stoma in making the anastomosis. This oralis totalis technique works out very well whenever the stoma is not more than 3 inches. It must also be realised that a large stoma in a dilated

stomach will get much smaller when the stomach returns to its normal size later. If however, the stoma is bigger than this, the Hoffmeister method of closing the upper part of the opening in the stomach, is made use of; and only the lower 2½ inches of the stomach is utilised for the stoma, specially when there is no abnormal dilation of the stomach from atony. In this way the stomach is prevented from emptying instantaneously, and whatever little gastric digestion is possible, is made use of. The anastomosis is made either iso or anti peristaltic as the guts fit best.

If the stomach is quite mobile, the von Petz sewing machine can be used to advantage. This evidently saves time, but cannot be used for all cases as often there is no room for the heavy clamp when the stomach is cut high up, and the cardiac end cannot be brought out of the abdomen.

A jejuno-jejunostomy between the proximal and distal loops obviously helps in emptying the proximal loop, and a more comfortable post-operative period is ensured. This however is not quite an essential step, and if the operative time has not been any too short, it is much wiser to save the extra 15 minutes required for this step by abandoning it altogether. About the end of the first post-operative week it may come to pass that the anastomosis suddenly stops functioning, particularly if an entero-anastomosis has not been made. However, as Balfour mentions, and we have found to our gratification, the anastomosis will just as suddenly, restart functioning if allowed complete rest, and gastric suction is maintained in the meanwhile. This passive treatment may have to be continued for a week or more before success is attained.

The abdomen is finally closed in layers. However, in the emaciated patient already under anæsthesia for long, where time is short, an all layer wire closure through the skin, muscles and peritoneum gives excellent results. In a devitalised patient this type of closure is further helpful in preventing evisceration and the fear of hypostatic pneumonia is minimised as the patient can be kept free-turning in bed from the first.

## POST-OPERATIVE TREATMENT

The value of modern post-operative treatment cannot be over-emphasized. Success or failure very often depends on how well this part of the treatment has been carried out.

The general principles of post-operative treatment are applicable to all gastric cases and complications are treated as they arise.

### General Principles:

(1) *Treatment of Shock*:—On immediate return from the theatre the patient is placed in moderate Trendelenburg and a blood transfusion is given if necessary. Often a transfusion has already been given during surgery and further administration of blood will depend on the amount of shock present. Blood pressure and pulse readings are taken every half-an-hour for the first 18 hours, as it often happens that secondary shock after 12 hours is more dangerous for the patient than immediate operative shock, and whole blood transfusion or plasma administration at the correct time may prove life saving. When the blood pressure is very low a slow intravenous drip of 5% glucose in water is best continued throughout the night and adrenal cortex extract is given as often as necessary to maintain the blood pressure until the critical period is safely passed. Stimulants are quite contra-indicated at this stage, with the possible exception of "coramine" or "nikethamide" which is also a respiratory stimulant, and which may be given as an emergency. The use of morphia in gr. 1/6 doses subcutaneously is an absolute necessity every 4 to 6 hours, to keep the patient quiet and at rest without pain. Of course a check on the respiration is very essential and if the rate drops to 12 or less per minute morphia has perforce to be omitted. Oxygen in amounts of 6 to 8 litres per minute is given continuously.

A standing order is left with the nurse in charge to turn the patient on the sides every two hours. This counter-acts in a large measure the tendency to hypostatic congestion and pulmonary embolism, and also acts as a deterrent to the formation of bed-sores in older patients.

(2) *Decompression of the Gastro-intestinal Tract*.—The amount of water given

by mouth depends on the degree of retention of the gastric contents. Nothing is however given till 24 hours after surgery. Continuous suction is maintained, by connecting an indwelling stomach tube to a Wangersteen<sup>10</sup> type of suction. Some patients are so fastidious that they do not tolerate a nasal tube for long and in these, an intermittent aspiration of the stomach contents can be carried out once every 3 hours or so.

Blood usually disappears from the stomach drainage, within the first 18 to 24 hours, and within 48 to 72 hours hardly 150 cc. of gastric contents can be aspirated in a day.

Water by mouth may be given in sips after the first day, but with the suction-tube kept open, so that it is immediately drawn up. This keeps the patient comfortably moist in the throat. After the third day 1 to 2 ounces of water is allowed every hour, with the stomach-tube clamped for some time afterwards. This allows the water to pass through the anastomosis and get absorbed in the system. The amount is increased daily, as less and less retention is encountered. About the fourth day diluted and strained milk is added, followed later by strained vegetable puree bouillon etc. Soft diet can be given about the tenth day and a normal diet at the end of the month. Those cases who develop oedema of the stoma need aspiration for a fortnight or more but otherwise, the stomach tube can be removed as soon as retention falls below 80 to 100 cc. in 24 hours i.e. by the fourth or fifth day. After the fourth day a nasal tube causes pain in the throat and a likelihood of pulmonary complications arises. So it is best to carry on with intermittent insertion of the tube to aspirate the stomach, after this period.

(3) *Medication etc.*:—If suction has to be carried out for a long time Vitamin K has to be supplemented parenterally, otherwise hæmorrhages may occur from prothrombin deficiency as shown by Clark<sup>11</sup> et al. Vitamin B complex and Vitamin C should be continued, as in pre-operative treatment. A serum protein estimation by the fourth day will indicate the need or otherwise for the administration of plasma, serum or allied preparations. Anæmia will indicate fresh whole blood transfusion and liver therapy.

(4) *Body fluids and electrolytes* need careful balancing immediately after any abdominal operation. It is only in recent years, that we have realised the real significance of the insensible fluid loss occurring in every case of abdominal surgery. A positive fluid balance of 1000 to 1500 c.c. on the side of the intake, is an absolute necessity. Further work is necessary to estimate accurately how much fluid loss actually occurs at the time of operation when the cœlom is exposed to the air. Some observers have expressed a view that the total fluid loss in a long drawn out abdominal operation is in the neighbourhood of 8 to 10 litres. Nobody however tries to replace as much fluid post-operatively. As a rule we give between 2000 to 3000 cc. of 5% to 10% glucose in water daily intravenously for the first 48 hours. Collier<sup>12</sup> has shown that there is an intolerance to salt up to 48 hours after major surgery so that glucose in saline is given only after the second post-operative day. In older patients sub-cutaneous fluid administration is a safer procedure though more painful. Fluid by proctoclysis gives less assurance of its utilization by the body as it is occasionally evacuated in full, even  $\frac{1}{2}$  to 1 hour after its administration by the usual slow drip method. This gives a false impression of fluid intake and also puts an additional strain on the nursing staff.

(5) *Retention of Urine*.—The treatment of this problem may be taken up here, as it is more or less a physiological condition with many a patient after abdominal section. It is commoner in the male and may be quite distressing at times. If enough fluids are given, a good quantity of urine is indeed secreted but that does not mean that it can also be voided. With prolonged catheterization there is every likelihood of precipitating a cystitis and ascending infection. "Moryl" given parenterally often acts very dramatically and the patient passes urine within 15 to 20 minutes of its administration. It is in the extremely rare case that a tidal drainage of the bladder is necessary, as after major rectal surgery.

(6) *Administration of Oxygen*.—A high oxygen concentration in the inspired air for the first day or two is a useful measure in

preventing the gaseous distension of paralytic ileus, besides combating the shock after operation.

Fine<sup>13</sup> and his associates have shown, that about 60% of intestinal gases is nitrogen, and that it is possible to remove these by a process of diffusion, if the patient is made to breathe an atmosphere, in which the partial pressure of these gases is maintained at a lower level. This is achieved by giving a high oxygen concentration in the inspired air, either by means of an oxygen tent or preferably by employing a B.L.B. mask.

In many cases atelectasis is also thereby prevented, as the respiratory rate is decreased by giving this high percentage of oxygen thereby helping the patient in expelling the mucous with a voluntary effort.

## COMPLICATIONS

### (i) Distension and Paralytic Ileus:

Paralytic ileus of some degree is very often met with after major abdominal surgery. For the first 24 hours it is nature's way of giving rest to the parts. If it persists much longer, the distension caused from an accumulation of gases and fluids calls for active treatment. The stomach and upper intestines collect a good deal of gas, mainly swallowed by mouth. This is appreciably augmented by fermentative processes, and by diffusion of nitrogen and other gases from the blood.<sup>14</sup> All these combine to give the final picture of post-operative distension which causes so much worry to the surgeon and as much distress to the patient. In addition to oxygen therapy, gastro-intestinal suction as already described above, promptly relieves this condition and if started immediately after, or even during the operation, is an excellent preventive measure in allaying the ileus. Once this condition is established however, prostigmine and pituitrin injections every four to six hours combined with a linseed poultice and flatus tube insertion are strongly indicated. The Abbot-Ranyon and other similar double lumen tubes are ideal for overcoming distension and giving nutrition safely, at one and the same time. The tube is inserted past the anastomosis and a high protein feed can be given straight into the jejunum, maintaining suction of the stomach simultaneously. It is here that the



value of amino-acids and protein hydrolysates is seen.

Hiccup is a sign of distension of the stomach even though the stomach tube is in place, and merely indicates that the lumen is blocked. The treatment is obvious. Acute dilatation of the stomach is best treated by continuous suction which is also the best preventive measure.

## (ii) Pulmonary Complications:

There are three main types of pulmonary complications met with post-operatively viz. atelectasis, bronchopneumonia and pulmonary embolism. Atelectasis is by far the commonest and occurs with equal frequency after general inhalation or spinal anaesthesia. It is due to blockage of a bronchus by a plug of viscid mucous followed by collapse of the corresponding part of the lung. The characteristic clinical picture makes diagnosis fairly easy. There is a sudden rise of temperature, pulse and respiratory rate; often within the first few hours. Physical signs of collapse can be easily elicited and X-ray examination is always definitely conclusive. The patient should be turned over to his normal side and must be kept turning on this side from his back, quite frequently. In this manner and also by tapping the affected side with the flat of the hand on asking the patient to cough; or by compressing the thoracic cage with a hand on each side during voluntary coughing; the mucus plug is made to dislodge from the bronchus. Inhalation of 5% carbon dioxide with oxygen also helps, by increasing the depth of respiration; the oxygen decreasing the rate of respiration as already mentioned. Both these gases thus help in the expulsion of the mucous plug. Opiates should be restricted as they inhibit the cough reflex. However, the best therapeutic measure is to carry out bronchial toilet<sup>15</sup> through an endo-tracheal tube, passed either blind or under vision using the laryngoscope. This may cause annoyance and discomfort to the patient but is of immense benefit. Very often the violent fit of coughing induced by the indwelling tracheal tube is in itself of sufficient force to blow up the viscid mucoid material. However it is always beneficial to take the additional help of the suction machine to draw out any mucous left over in spite of the expulsive cough.

A gum-elastic or rubber catheter attached to a suction machine is passed through the endo-tracheal tube into the bronchi to aspirate the contents.

As soon as the blockage is cleared temperature falls dramatically and the pulse and respirations return to normal just as quickly.

## Bronchopneumonic Complications:

Bronchopneumonic complications are suspected by many to-day, to be in reality due to pulmonary infarcts or infection added on to atelectatic areas. Whatever the facts may be, a rapid response is obtained by using the sulfa drugs or penicillin, and oxygen.

## Pulmonary Embolism:

This seems to occur in about 0.5 per cent of all abdominal operations. Frequent changes in position of the patient from side to side and elevation of the foot of the bed are the usual preventive measures tried by us. We have not yet used heparin<sup>16</sup> intravenously as suggested by some surgeons. This problem still remains unsolved in post-operative treatment.

## (iii) Gastro-intestinal Obstruction:

Obstruction at the anastomosis will be present in most cases and is due to development of oedema at the stoma; and where the anastomosis is retro-colic, in the adjacent transverse mesocolon. This oedema is inflammatory in nature and subsides within a few days. In rare cases obstruction occurs from mechanical causes resulting from defective operative technique.

Delayed obstruction at the stoma occurs occasionally in the second post-operative week. In most instances it is due to over-feeding the patient and to starting solid food too early. The pulse occasionally rises. This condition arises from gastric atony and constant Wangensteen type of gastric suction relieves it very efficiently.

Mechanical obstruction is manifest immediately post-operative and the patient retains very large amounts of gastric secretion from the first day. The retention does not decrease at all subsequently. Operative measures are evidently indicated in order to correct this

defect arising from an originally faulty surgical technique. But as far as possible all non-operative aid is first sought and only as a last resort surgery is contemplated.

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# PENICILLIN THERAPY IN ACUTE INFECTIONS

By

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The progress of medicine with regard to the treatment of acute conditions becomes striking when the conditions prevailing in the past is reviewed. Time was when man in his desire to save himself from acute infections invoked spirits and practised incantations and sacrifices to appease them; later, when his intelligence improved and division of labour in the community occurred, a medicine man appeared on the scene, who in addition to invoking spirits, tried plasters, used infusions, decoctions and various other vegetable drugs. With the realisation that bacteria were responsible for the causation of acute conditions and not disturbances in the 'balance of power' of humours in the human body and as a result of the epoch making discoveries of PASTEUR, KOCH and others, many attempts were made to kill these organisms both *in vitro* and *in vivo* by antiseptics. It was, however, found impossible to kill these organisms without injury to the animal itself. This is well illustrated by what is commonly known as "VON BEHRING'S LAMENT." He stated in the year 1880:

"It can be regarded almost as a law that the tissue cells of man and animal are many times more susceptible to the poisonous effects of disinfectants than any bacteria known at present. Before the antiseptic has a chance either to kill or inhibit the growth of the bacteria in the blood or in the organs of the body, the infected animal itself will be killed. Therefore, anybody who pessimistically declares that disinfection in the living body is for all time impossible appears justified."

This despondency persisted for a long time until EHRLICH interested himself in the specific staining characteristics of certain aniline dyes in various tissue cells, based on

the work of his cousin WEIGERT. WEIGERT stated that there were certain specific receptors within the cells which are capable of combining selectively with various chemical agents. EHRLICH'S trypan red experiments on mice infected with trepanosomes were effective in mice, but proved to be ineffective in other animals so infected. The word chemotherapy was coined by EHRLICH; it literally means "treatment by chemicals" and includes treatment by aniline dyes and various organic salts derived from them.

The discovery of Salvarsan in 1910 for the cure of Syphilis was a contribution in the direction of chemotherapy. Though a lot of work was done in between, nothing more was substantially achieved until 1932 when DOMAGK discovered Sulfanilamide for the cure of streptococcal acute infections. This new drug was synthesised and re-synthesised and many other new derivatives were found thus increasing the scope and range of usefulness of these drugs in controlling infections. Though there are certain dangers attendant on their administration yet, when administered with care, the bacteriostatic action of these drugs on organisms has been definitely proved. Much literature has accumulated relating to the advantages and disadvantages of this drug and allied derivatives in acute infections. These new drugs are more bacteriostatic than bactericidal.

The recent discovery of PENICILLIN is a realisation of the echo of DUBOS of the Rockefeller Foundation who, in 1940, visualised the use of remedies of plant origin. The discovery of GRAMICIDIN, allied to Penicillin led to the discovery of many other antimicrobial substances produced by the lower plants, the

bacteria and the fungi, such as, fumigacin, clavacin, streptothricin.

DUBOS discovered that a bacterial species commonly found in the soil, *BACILLUS BREVIS*, produced a substance which kills other bacteria. He called the active substance GRAMICIDIN in honour of CHRISTIAN GRAM,—one of the pioneers in bacteriology, who discovered the staining reaction by which all bacterial species are divided into two large groups—the so called gram positive and gram negative bacteria. As gramicidin acted on gram positive organisms, he named it GRAMICIDIN.

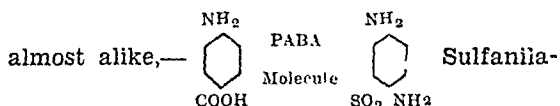
The peculiar bacteriostatic behaviour of PENICILLIN was first discovered in 1929, but was put into practical use for the benefit of humanity only in 1942 by FLORY and his collaborators.

It has not so far been possible to establish the chemical composition of this wonderful chemo-therapeutic drug. A lot of experimental work has been going on to bombard the molecule and it is a pleasant thing to hear that the formula has just been found. It only remains to synthesise it in test tubes and when this is accomplished, it will be an important discovery in the domain of chemotherapy; such a test tube production replacing the present expensive and elaborate methods of culture and extraction will reduce the cost to a large extent and make it possible to be tried in a variety of acute infections on a larger scale.

#### PENICILLIN AND ITS ACTION:

Penicillin is a metabolic product, probably protein in nature, synthesised by the mould *Penicillium Notatum*. This, when purified, concentrated and dried becomes a golden yellow powder or a cake (recent experience of a manufacturer's product squibbs) called Penicillin. It is acid in nature and is quickly destroyed and therefore it is combined with alkaline salts of sodium and calcium, for making it more stable. The sodium salt is more hygroscopic than the calcium salt but the latter is more stable and less irritating. This powder contains only 10 to 30 per cent of the active substance, the rest being impurities which, luckily, are nontoxic. This drug is rapidly destroyed by alkalies and acids in

concentration, by metallic salts, alcohol and oxidising agents and heat. Therefore it is necessary to keep it at a constant temperature of not less than 10 degrees Centigrade or 50 degrees Fahrenheit. It is also destroyed by the action of an enzyme called "PENICILLINASE" which is produced by the action of other organisms and therefore it will be less effective when employed in cases where there is mixed infection by organisms which are inimical to Penicillin. The action of this drug is purely bacteriostatic and works on the basis of the finding of DUBOS of micro organismal antagonism. The action of sulfanilamides as explained by wood perhaps bears resemblance to the action of Penicillin. Wood has stated that, bacteria, for their multiplication, require and, therefore, absorb a lot of para-amino-benzoic acid. The molecule of para-amino-benzoic acid and that of sulfanilamide being



mide molecule—the bacteria in their inability to differentiate the difference in the molecule get easily fixed with the sulfanilamide molecule which instead of providing food for them, prevents them from multiplying. MACLEOD has the action explained by a pithy simile—just as the trout get easily baited and hooked by the fly on the hook being unable to differentiate between the fly on the hook and the ordinary fly which it is accustomed to swallow, so also the bacteria get easily hooked to these sulfanilamide molecules being unable to differentiate between the para-amino-benzoic acid molecule and the sulfanilamide molecule. It is a notable feature that Penicillin acts even in the presence of a large amount of para-amino-benzoic acid in the wounds.

CHAIN and DUTHIE have suggested that Penicillin acts better on the dividing organisms by producing lysis. CAVILITTO and BAILEY have stated that Penicillin acts by interfering with the utilisation of the thiol groups by the growing cells. It is quite possible that it may form part of an enzyme system replacing the normal bacterial enzyme; thus the cell may become susceptible to the action of Penicillin at the time of division, or the Penicillin may become activated to produce

anti-bacterial substances or the cell may become cooked in its own juice by the time it divides.

In recent times it has come to our notice that Penicillin is not a panacea for all acute infections and that its efficacy depends upon its extraction by the various cultural methods employed. It has been found that the Penicillin cultivated and extracted from submerged culture called Penicillin G is the most potent in its effect on acute conditions. Therefore the therapeutic values depend upon the Penicillin that is used. At present there is no information sent with the bottle regarding assay of potency or other factors relating to the particular product, nor is the method of production stated and therefore it is difficult in the present circumstances to assess accurately the therapeutic value of Penicillin. At present, purification and fractionation is being done by crystallisation and until the fractional factor is assayed and noted on ampoules put on the market it would be difficult to assess the value of Penicillin treatment. Till then in evaluating the results we are only considering the effects of crude Penicillin.

McILLWAIN has shown that the sulphur containing molecule of Pantothenic acid (VITAMIN B) prevents, in experimental animals, the growth of the hemolytic streptococcus. This shows that slightly changed food factors can be used for bacteriostatic action as in the case of para-amnio-benzoic acid.

Our present knowledge of the action of these drugs is meagre and still is in the domain of hypothesis and requires elaborate experimentation and biochemical investigations to substantiate these hypothetical concepts.

When Penicillin is injected, it is found that it is absorbed in about 15 minutes and is available to the tissues in fair concentration to carry on the bacteriostatic work against the gram positive bacilli and cocci and gram negative cocci which are susceptible to its use. About 58 per cent of Penicillin is excreted by the kidneys in the first hour and at the end of three hours it is completely excreted and hence the necessity for 3 hourly administrations to keep the drug in fair concentration

in the tissues for continued bacteriostatic action.

Penicillin can be administered locally as an insufflation, in combination, if necessary, with sulfathiazol for staphylococcus and sulfanilamide in the case of streptococcal infections, in the proportion of 5,000 units to 1 gramme and is useful in compound injuries when local application is indicated. Penicillin Sodium in powder form is irritating to the tissues and so has to be used in solution (250 units per c.c.) in severe infections. The calcium salt is tolerated and is more stable and can be used in powder form.

### Oral Administration:

Oral administration of Penicillin is of doubtful utility though experiments are being tried and it is doubtful whether fair concentration in tissues will result from absorption from the intestines. It is well known that it cannot stand the acid tide in the stomach and even if this is circumvented, will inevitably succumb to the alkaline tide of the small intestines.

Necessarily, the best way to secure good results will be the parenteral administration by the intravenous, intramuscular and the intra-theal or intra-ventricular routes. Penicillin is dissolved in pyrogen free distilled water or normal saline or 5 per cent Glucose or Plasma or even whole blood. Dry Penicillin in powder form keeps well but once it is dissolved it becomes unstable unless it is kept in a refrigerator at a constant temperature of 4 degrees Centigrade. In solution it can be kept without deterioration for 48 hours or longer, but it is always safer, under tropical conditions, to use the solution as quickly as possible after it is made.

The intravenous route, though the easiest method of administration, cannot be maintained for a long time due to the dangers of thrombo-phlebitis. The dilution suggested is 20 to 50 thousand units per 1000 c.c. It is to be given slowly at the rate of 20 to 30 drops a minute to control heavy infections. To avoid thrombo-phlebitis, a combination of Heparin with Penicillin would be a distinct advance and is being done in America. But due to the difficulty of obtaining this sub-

stance in India, this has not been practised. If the intravenous medication is to be given at stated intervals, 1 to 5 thousand units are dissolved in 2 to 5 c.c. of pyrogen free distilled water and given slowly. It has to be repeated periodically every hour as it is excreted rapidly by the kidneys and is the method of choice to initially control the heavy infections.

The safest and most sound method of administration is the intramuscular injection and the method adopted is 15 thousand units dissolved in 1 to 2 c.c. of pyrogen free distilled water and given intramuscularly every three hours. This is the method adopted in the Stanley Hospital, Madras. Continuous intramuscular drip has been used like the intravenous and is adopted in heavily infected cases. This method cannot be carried on without discomfort to the patient and can be first adopted for a period of six hours delivering 5000 units every hour.

To promote prolonged action by this method, a mixture of Penicillin in peanut oil and bees wax is being tried, but this preparation is not available and works on the same principle as protamine insulin by slow absorption and will be a distinct advance as the number of injections would be minimised.

Intrathecal administration and intracerebral administration are indicated in cases of meningitis as only very small quantities are secreted in the C.S.F. if given by the intravenous and intramuscular routes. The method practised for intrathecal administration in the Stanley Hospital is to give 50 to 60 thousand units intrathecally in 5 c.c. of pyrogen free distilled water after withdrawing an equal quantity of C.S.F. This quantity is given once a day and appears to be effective when combined with intramuscular injections. It has not been possible with our limited staff to do elaborate examinations of the blood and the C.S.F. at periodical intervals and thus it is not possible to give a scientific dosimetric evaluation of this method. However, this method has given satisfaction in the cases treated and therefore is published.

Local application may be made for abscess cavities, empyema cavities and so on. In all these conditions, it is essential that if there

is a lot of pus already formed it is necessary to empty it before using Penicillin and the quantity used depends on the size of the cavity—20 to 50 thousand Oxford Units in 30 to 40 c.c. saline may be considered ample for cavities of large sizes like empyema cavities.

Continuous intramuscular and intravenous administration of Penicillin have been practised in cases of burns. The method and dosage adopted is the same as in other cases.

Laderle Laboratories Inc. have now introduced "Penicillin Pills" suspended in oil and encased in gelatine capsules to prevent digestion by the gastric juice. It is stated in their report that the Penicillin is absorbed unaltered and without deterioration into the system and will obviate the disadvantages of parenteral administration; it is hoped however that the cost will not be prohibitive.

There are limitations to the usefulness of Penicillin:—

(1) Penicillin is unstable in solution and requires careful handling.

(2) Penicillin must be administered continuously as it is excreted very effectively, in about 3 to 4 hours time.

(3) Some of the sensitive organisms may develop resistance to Penicillin if given in small doses. Organisms become resistant to Penicillin by developing the enzyme called Penicillinase and such mixed infections may require Penicillin with Sulfanilamide to control the organisms which are not sensitive to Penicillin.

(4) In all traumatic conditions, *debridement* of the wound has to be done for the effective action of Penicillin.

(5) Penicillin will not find its way through thick fibrous walls and so is useless where such conditions exist unless the barrier is broken

(6) In very heavy infections and when started late in the course of the disease, Penicillin may not give the dramatic results expected of it.

## COMPLICATIONS OF PENICILLIN TREATMENT

Penicillin may cause some reactions; the commonest recorded are thrombo-phlebitis, urticaria, fairness and flushing of the face, muscle cramps, allergy and pain at the site of intramuscular injections. These are however, uncommon with the exception of thrombophlebitis which may occur in continuous intravenous therapy and can be averted by giving Heparin. There was only one case of Dermatitis after intramuscular injection in a case of diabetes. The rash, however, was so alike heat rash that it is not possible to ascribe it definitely to Penicillin.

It is however, a great strain for the general practitioner to administer this drug in private practice at 3 hourly intervals unless he has a nursing home or reliable nurses who can give the injections at stated periodic intervals.

Cases have come to the hospital stating that Penicillin also had been given to them with no effect and when enquiries are made it is found that 100,000 to 120,000 units have been given in three or four doses according to the convenience of the medical practitioner and it is needless to say that this method is useless for reasons that have been given while dealing with the action of Penicillin.

The experiences in 78 cases of acute infections in civil practice are described in this paper; the clinical results, though not supported by repeated scientifically based checks such as repeated bacteriological examination, testing of concentration of Penicillin in blood and excretion rate, etc. have been so good as to deserve enumeration as will be seen from the detailed list of cases appended to this paper.

In conclusion, I must thank Dr. C. Raghavachari, M.S., F.R.C.S., Dr. K. C. Nambiar, F.R.C.S., Dr. V. C. Sundarsanam, M.B.B.S., D.O., Dr. M. N. Prabhu, M.B.M.S. and Dr. P. Natesan, M.B.B.S., Surgeons of this hospital and Dr. P. Kutumbiah, M.D., M.R.C.P., Dr. P. Arunachalam, M.D., M.R.C.P., T.D.D., D.M.R., Dr. K. C. Paul, M.D., and Dr. S. Rajagopalan, L.M.S., F.D.S., the Physicians of the hospital for placing at my disposal

the clinical material with notes of treatment by Penicillin for purposes of review.

Table showing summary of cases treated:—

Disease	Total No. of cases	Cured	Relieved	Died
1. Brain abscess	2	1	1	—
2. Meningitis	2	1	1	—
3. Eye cases	4	2	2	—
4. Sinusitis	6	2	3	1
5. Empyema	4	3	—	1
6. Lung abscess	6	5	—	1
7. Osteomyelitis	5	5	—	—
8. Compound fractures	3	2	—	1
9. Syphilis	1	1	—	—
10. Gonorrhœa-acute	7	5	2	—
11. „ chronic	3	1	2	—
12. Cellulitis	6	5	1	—
13. Pyæmic abscess	8	8	—	—
14. Furunculosis	2	2	—	—
15. Impetigo	3	—	3	—
16. Cancrum oris	6	4	—	2
17. Carbuncles	5	5	—	—
18. Gas Gangrene	1	1	—	—
19. Tropical ulcer	1	1	—	—
20. Burns	3	3	—	—
Total ..	78	57	15	6

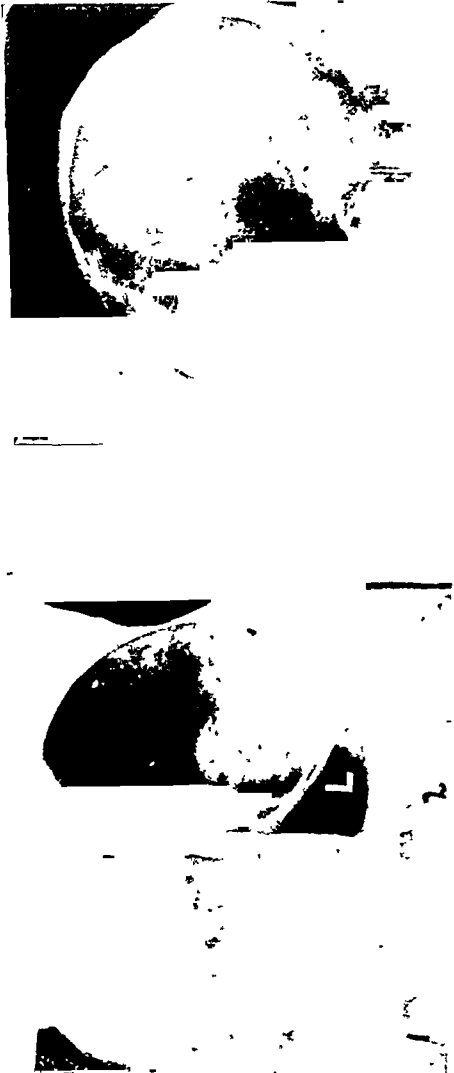
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# BRAIN ABSCESS

Nationality, sex and age, admission, discharge.	Date of admission, discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H. M. 45 6-3-15		Intradural brain abscess (right temporo-sphenoidal lobe)	Urine—nil abnormal Blood—WBC 15,000 18-8—Pus from abscess-culture streptococcus grown, pus of wound 3 days later: B. Pyocy- CSE—Total proteins 35 mgms %, Sugar 65 mgms. % Chlorides 66 mgms % Cells 4 per c mm. X-Ray mastoid: Large cellular mastoid, destruction of mastoid cells, cells extending to squama, show destruction on the right mastoid.	History of right ear discharge for 2 months, swelling of right mastoid region, operated for right mastoid on 22-7-45 Discharged after 10 days with healed wound, attending outpatient for observation. On 5-8-45 patient was feeling feverish at night and headache and frontal pain and sleeplessness and so readmitted on 6-8-45 Condition on admn. Patient apathetic drowsy, pulse 50 pm temp. 98.4, resp. 18 pm General condition poor, patient not answering questions freely, slight swelling of right temporal region present Developed left hemiparesis.	6-8-45—Penicillin 20,000 units per dose, 300,000 units given. 9-8-45—Slight improvement in condition. 10-8-45—Old mastoid incision enlarged, bridge removed. Tegmen tympani et antrum removed together with a portion of squama of temporal bone, sub temporal decompression; wound packed with iodoform gauze. 11-8-45—Another course of 400,000 units which controlled temp. slightly. 16-8-45—Patient was getting more drowsy, left side hemiplegic. The wound was therefore explored under local. Outer wall of squamous bone further removed. Dura was bulging and taut Aspiration with a syringe 30 cc. of thick pus removed 1½" distance from the surface and 15,000 units of penicillin in 15 cc. of normal saline put in and later dura was incised by cataract knife and small drainage tube put in 17-8-45—Penicillin continued Another 100,000 units, 20,000 units every 3 hours. Dural fluid under tension. Lumbar puncture done. 18-8-45—Aspirated about 10 cc of pus—drainage tube put in 19-8-45—Very little pus general condition was much better Hemiplegia disappearing Dressing of wound changed daily. 7-9-45—D. R. removed, patient alright, mental condition good.	Patient's general condition improved much after operation and drainage of pus. Mental condition came to normal. Penicillin in the first instance might have helped localisation of the abscess without spreading.

BRAIN ABSCESS—Case No. 1.



X-ray of mastoid—Cellular element destroyed—Right side.

X-ray of mastoid left side—Moderately Cellular mastoid.



# RAIN ABSCESS—(Contd.)

Nationality, sex and age.	Date of admission, discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
2. H.F. 21	7-5-15. 1-9-15.	Meningo-encephalitis of otitic origin.	Urine—normal C.S.F. culture sterile. Total protein 10 mg. Chlorides 690 mg. Cells 5 pc. mm. WBC 9250 R.B.C. 4.5 millions. No M.P. WE negative. Kahn negative. Fundus left eye papilledema; right eye optic atrophy. X-Ray of mastoid left mastoid acellular, Right moderately cellular, normal outline of cells. Sinuses nil definite.	Brought in with fever 101.5 of a month's duration with left ear discharge. Blindness of right eye. Severe headache, paralysis of right 3rd nerve dilatation of right pupil, facial paresis of right upper motor type, knee jerks normal, plantar flexor, right side neck glands slightly enlarged. Right ear tympanic membrane perforated, marginal perforation. Hearing left ear defective Fundus—right eye—picture suggests atrophy (secondary) Left eye papilledema, field narrowed mostly temporal.	Started on penicillin 30 0/0 units every three hours intramuscularly for 11 doses. Later 10,000 units intramuscularly for 19 doses. Total 520,000 units. Later followed by Cibazol 6 tablets for a couple of days. After the administration of penicillin the temperature promptly came to normal, headache disappeared, pupils reacted to light. No evidence of facial palsy, left eye papilledema disappeared. Right eye blind with very slight perception of light. Mastoidectomy was not done as the left ear discharge disappeared, there was no mastoid tenderness, hearing was better and being acellular it was considered not to have any interference with the ear for 6 months as the lesion is quiescent.	Patient cured of the complaint and has been asked to report after six months.

TEMPERATURE AND PULSE CHART—Case No. 1.

Sundermann

BRAIN ABSCESS

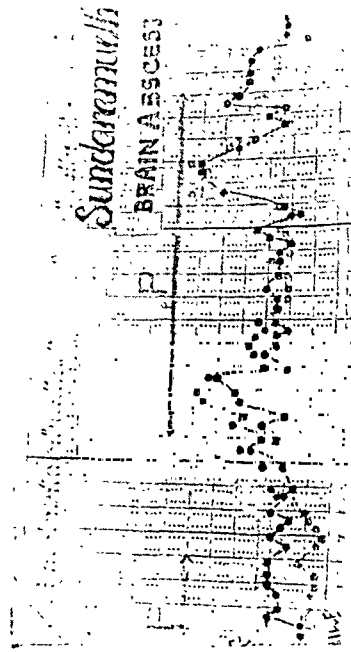
TEMPERATURE AND PULSE CHART—Case No 2.

Satharam

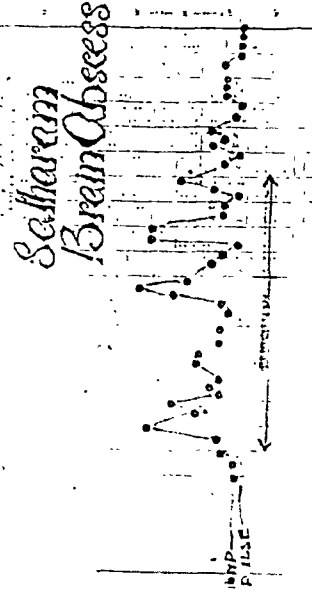
Brain Abscess

Two cases were treated. One of them was an intracranial drainage and the other was an extracranial drainage.

TEMPERATURE AND PULSE CHART—Case No. 1.



TEMPERATURE AND PULSE CHART—Case No 2.



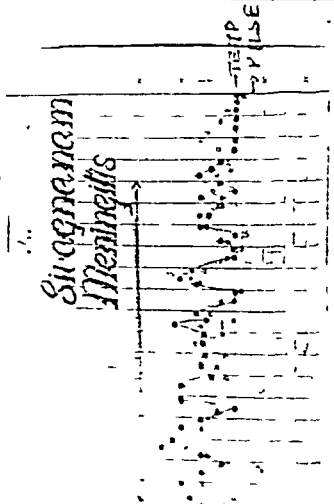
Temperature and pulse chart of the patient.

Two cases were treated. One of them was an intradural abscess in the region of the right temporo-sphenoidal lobe treated with Penicillin before and after drainage and the other was a case of meningo-encephalitis treated with Penicillin without drainage. Both were of otitic origin. The intradural abscess definitely improved after the drainage and the success of the operation may be due to the localisation of the abscess due to the preliminary treatment with Penicillin and itself was drained along with Penicillin. In this case, mastoidectomy was done first, secondly the sub dural space was opened and thirdly the intra dural abscess the recovery was dramatic. Even after the opening of the abscess, drainage was a difficult problem as it became clogged. After free drainage

# MENINGITIS

Nationality, sex and age.	Date of admission	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H. M. 31	19-2-45 2-4-45	15-3-45 1-5-45	Meningitis-post spinal-duration 6 months.	Urine culture strepto grown Blood WBC—10,000 Poly 68% Mono 4% Lymph 20%  No microflaria CSF smear—a few pneumococci seen. No acid fast organisms seen culture—no growth	Got operated for Hydrocele under spinal 6 months ago. After 15 days of operation, he started fever with headache and pain in neck muscles for which he had all sorts of treatment for nearly 6 months—did not give any relief.	2/3-9/3-LP done. CSF slightly under tension. Opalescent, 5 c.c. of Penicillin 50,000 units put in. Total penicillin 400,000 units intrathecally daily for 8 days.  Had recurrences of symptoms and so another course of treatment was given 5/4, 12/4-8 injections of intrathecal penicillin given.  Total 400,000 units intramuscularly every three hours, 15,000 units.	After each Penicillin injection intrathecally the patient used to feel alright for about 12 hours. Later he used to get headache. But after 5th day he had no recurrence of headache, felt cool in brain, slept well. When attempting to get up, had pain in the lumbo-dorsal region where he had many spinal injections. Has reported that he is all again. Had again Penicillin outside in a nursing home & developed paralysis and is now being treated by indigenous methods with improvement.
TEMPERATURE AND PULSE CHART							
2. H. F. 25	23-7-45	3-8-45	Specific Meningitis duration 1 month.	Urine—nil abnormal 25/7—CSF smear, no organisms culture sterile, Khan—positive strong.	Headache started one year ago, slowly increased. Headache increased even with slight noise since 1 month. Had abortion 3 months ago.	LP done, CSF clear normal tension 50,000 units of Penicillin injected Total intrathecal (3) 150,000 units parenteral intramuscular 550,000 units Total do-age 700,000 units.	After three injections intrathecally, headache disappeared. Discharged cured and advised anti-syphilitic treatment.

TEMPERATURE AND PULSE CHART



Two cases were treated with Penicillin. One was a complication after a spinal injection of Percaine. The organism grown was pneumococcus and the other was a case of specific meningitis which followed an abortion. The immediate result of the treatment in the first case was good at the time of discharge. He had two courses of Penicillin administration in the hospital at two different periods with complete relief of symptoms. He was requested to come for demonstration and in reply has stated that the temperature re-started with headache again and he was advised to take another course of Penicillin by another consultant which he did in a private nursing home. Subsequently he developed Hemiplegia. He says he is recovering from the effects of it. The other was cured of the complaint and is undergoing anti-syphilitic treatment and has reported completely free from symptoms.

# EYE CASES

Nationality, sex and age.	Date of admission	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.F. 50.	28-3-45	4-4-45	Post-operative Iritis cataract extraction.		Operated on for cataract on 31-3-45. Developed Iritis on 4-4-45. Intractable Iritis, 4 days after the operation. Was treated with Soluseptasine. Neutral Iodine, leeches etc. for 10 days with no effect up to 13-4-45. Painful and congested eye.	13-4-45—Penicillin 100,000 units 20,000 units every three hours. Eye was quieting down. When seen the next morning there was slight exudate in the pupillary area. No photophobia. Slight, ciliary and conjunctival congestion.	Intractable post operative Iritis resistant to sulfanilamide therapy, responded well to Penicillin and allayed the acute process (infection) Patient discharged on 2-5-45 and advised to come later for capsulectomy.
2. I.C. 52.	20-3-45		"		Admitted on 20-3-45 for cataract. Extracted on 21-3-45. Developed intractable Iritis and Hyphema on 4-5-45. Vitamin C and K. Calcium etc. tried with no effect till 16-5-45.	16-5-45—Penicillin 100,000 units 20,000 units every three hours. Apparent improvement noted in the eye Hyphema persisted but little in quantity, congestion a little less but relapsed again after a few days. 30-5-45—Another 100,000 units given in the same way. Slight ciliary and conjunctival congestion and Hyphema persistent.	An intractable case of post operative Iritis resistant to all forms of treatment responded to Penicillin which allayed the acute process as long as the drug was in circulation but did not completely bring down the acute infection.
3. H.M. 40			Retro bulbar Neuritis		This patient has been having Diplopia since 1936 and consulted Dr. Eischnig of Prague, who did an operation on the ocular muscle and prescribed glasses with prism. The condition was better for sometime and the Diplopia returned. He was diagnosed by Physicians in Vienna, California and New York as a case of multiple sclerosis.	30-5-45, 200,000 units of Penicillin, 20,000 units every three hours. After the 200,000 units the patient complained of unsteady gait which cleared. His writing which was done with great effort clumsily, returned almost to normal and for the first time since 1936 was able to shave himself with both eyes open before the mirror. This case requires watching and observation.	The patient stated that he was able to see better in the affected eye after Penicillin therapy.

Post-operative  
Dacrocystitis.

4 M.F. 35.

Radical dacrocystectomy done about a month back but wound did not heal in the ordinary way. Tender and painful, diffuse edematous swelling on the left side of the face with a small opening through which pus is seen to come out on pressure.

22-5-45 — Penicillin 100,000 units 20,000 units every three hours. Local condition much better after 3 hours. Swelling, redness and pain relieved after 60,000 units of the drug.

23-5-45—Another 100,000 units repeated the same way. All acute symptoms completely subsided when wound was examined the next day.

An intractable post-operative dacrocystitis resistant to sulfanilamide therapy responded to Penicillin. All acute symptoms completely subsided.

Four cases of different types of eye diseases were treated. One was a case of Iritis after post-operative cataract which was sulfa-resistant and responded well to Penicillin, and allayed the acute process. Patient was advised to come later for capsulectomy to which she did not respond.

The other case was a post-operative Iritis resistant to all forms of treatment, responded to Penicillin which allayed the acute process. 100,000 units of Penicillin was administered, but the symptoms recurred the moment Penicillin was withdrawn.

The third case was a case of Retrobulbar Neuritis of nine years duration which reacted satisfactorily to Penicillin therapy.

The fourth was a case of Dacrocystitis which was sulfa-resistant and reacted well to Penicillin therapy.

# EAR, NOSE AND THROAT

Nationality, sex and age	Date of admission	Date of discharge	Diagnosis.	Investigation.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.M. 25	9-2-45 O.P.		Bilateral chronic maxillary sinu- sitis.	Pus culture—N catarr- halis and pneumo- cocci.	Discharge through nose thick. 7 years duration, head- ache. Transillumination both maxillary antra opaque. X-ray confirmed. Washed more than a dozen times, no improvement.	Patient was treated previ- ously for a long time with antrum puncture and wash- ing but no relief. 8/2—Penicillin through puncture canula; 10,000 units per dose in 5 c.c. of saline every 3 hours. Total 14 doses 140,000 units.	The patient is a medical student. Till now he has no recurrence of the trouble. Got cured. 22-10-45—Reported quite fit. Has no discharge but has slight head-ache.
2. M.M. 27	10-1-1945		Right chronic maxillary sinu- sitis with septic tonsils and de- flected septum.	Pus culture—pneumo- coccus grown.	Discharge from nose. Head- ache since 6 years. Right maxillary antrum Transillu- mination opaque. X-ray con- firmed the illumination test. Operated on in Bombay. No improvement. Head-ache left side.	First, operation for septum and septic tonsils was done intranasal antrectomy was done. Penicillin 10 doses 10,000 units each locally in normal saline and intra- muscularly given 100,000 units.	6 months later patient has reported freedom from the symptoms.

X-RAY OF CASE No. 2



Note Haziness of Right Antrum  
(Before Treatment)  
X-RAY AFTER TREATMENT—Note  
the clearing of the Right Antrum.

3. I.C.F. 17

27-1-45  
O.P.

Chronic maxillary sinusitis and lung abscess right.

Pus culture Pneumonia and Catarrhalis.

Nasal discharge positive. Head-ache positive Transillumination left—crescent hazy, X-Ray confirmed.

Patient getting treatment for the same as O.P. On 1-3-45 she complained of fever, cough, spitting of blood. X-ray taken showed cavity of right middle lobe 150,000 units of Penicillin intramuscularly given 15,000 units. Referred to the medical side.

Good relief of trouble.

4. I.C.F. 22. 14-5-45

Maxillary sinusitis

Pus smear staphylococcus and streptococci grown.

Duration 3 years, discharge from nose, frequent attacks of cold and fever.

Pus in both maxillary antra punctured and washed. Penicillin 150,000 units intramuscularly every 3 hours 15,000 units given; 50,000 units given locally into both antra, 5,000 units at a time for 5 days.

5. H.M. 56. 11-8-45

Left Max sinusitis

Running of the nose both sides alternately Blocking of nostrils, bad smell in the nose, catches cold very often.

Penicillin intra-muscularly 200,000 units given and antra washed and 5,000 units Penicillin in 7 c.c. of normal saline weekly.

Patient very much better.

6. A.I.M. 20 5-7-45

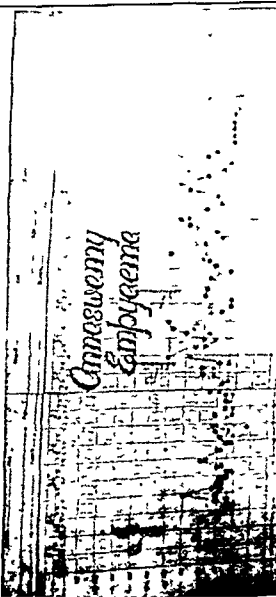
Sinusitis left

Frequent attacks of cold and cough. Pain in the molar region left.

Discharged cured.

For treating the maxillary sinusitis puncture drainage and instillation of Penicillin was practised with intra-muscular injections. Two have definitely been cured, three have improved and one died of acute lung abscess.  
Method of administration: Usually 5,000 units in 5 to 10 c.c. of normal saline is instilled through the canula daily for three to five days and in one case every three hours 10,000 units in 5 c.c. of normal saline.

# EMPHYEMA

Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.F.C. 7	1-12-44	2-1-45.	Empyema chest both sides following pyæmic abscesses 15 days duration.	1-12—Urine culture—staphylo grown. 13-12—pus culture from pleural cavity—strepto-staphylo grown. Blood—WBC-9,000 Culture-sterile 18-12—negative. 26-12—negative.	History of fever since 15 days Abscess inner aspect of upper part of left thigh. 2. Painful indurated swelling on the inner aspect of the right thigh. 8-12—Patient developed dyspnoea, general condition worsened hacking cough, brings sputum. 9-12—X-Ray right chest opaque.	Put on cibazol, Total 6 gms. Abscesses incised and drained. Chest aspirated with Potain's aspirator. On 10-12, 16-12 and 20-12 each time instilling penicillin after aspiration. On the 1st occasion, no pus struck. Penicillin locally into cavity 75,000 units 17-12—Parenteral 380,000 units, 10,000 units every three hours intramuscularly.	Patient responded well to Penicillin but suddenly died after a fit of cough. No post mortem was possible.
2. H.M.C. 1½	10-2-45	26-3-45	Empyema left 15 days duration.	Urine—nil particular. Blood—WBC-10,000 Poly 75%, Mono 5% Lymph 25% culture 21-2-45, Non-hemolytic streptococci grown.	History of fever and swelling on left side of chest, 15 days. Dyspnoea, signs of effusion on the left side—X-Ray whole of left lung field opaque.	Sulfanilamides by mouth. 10-2—Under local aspiration with Potain's aspirator 1 pint of pus; 13-2—aspirated 6 oz., 28-2 little pus, 1-3—Patient developed fever and dyspnoea again, 5-3—Penicillin started 300,000 units 12-3—rib resection and open drainage. Local penicillin 60,000 units 26-3—Sinus healed patient discharged.	After administration of penicillin, parenteral and local condition improved much, but pus in the pleural cavity became thick and could not be aspirated and so rib resection and drainage was done and was successful. The patient reported in June 1945. He is alright.
<div>  </div>							
3. H.M. 59	22-5-45	27-6-45	Empyema chest right 18 days.	Pleural fluid albumin 5.36 gm., Globulin 64 gm.% Culture 24-5—Pneumococci grown 1-6—pus culture sterile.	History of persistent high temperature for 18 days all of a sudden felt difficulty of breathing and sought admission. Signs of effusion present on the right side of the chest X-Ray confirmed clinical findings.	23-5—Under local 50 c.c. of pus aspirated and 40,000 units of Penicillin in 40 c.c. of sterile water put in. 28-5—Under local 80 c.c. of pus withdrawn and 40,000 units Penicillin put in 40 c.c. saline. 30-5—Under local 40 c.c. of pus aspirated and 40,000 units of Penicillin put in.	27-6—Empyema resolved and culture was sterile after second instillation of Penicillin. Discharged. Reported stating he is alright.

4. H.M. 40	15-9-45.	25-9-45.	Empyema.	Pus culture-staphylo grown.	History of sudden pain in chest after exercise and later fever. X-Ray showed effusion. Got treatment on medical side for nearly 4 months and no improvement.	Started on Penicillin intrapleurally; for 5 injections 20,000 units. Later 400,000 units were given intramuscularly. Patient improved. Started on Penicillin again. In September he developed empyema after which he was transferred to surgical side on 25-9-45 where rib resection was done and drainage done. The pus was very thick. Through the D.R. 100,000 units of Penicillin put in 20,000 units at a time. The patient has recovered.	Rib resection had to be done as the pus was large in quantity. He recovered completely.
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Four cases of Empyema were treated with Penicillin. One of them died. This was in a girl aged 11 years (empyema of both sides was a complication of pyemia). She reacted very well to Penicillin and aspiration of pus from the pleural cavity. The temperature came down and she was progressing. Suddenly one night she collapsed and died. No post mortem was held to find out the cause of death.

The other three cases were discharged cured. One was in a child aged 11 years. The pus had become thick and a rib resection had to be done and the improvement was remarkable after drainage and the local instillation. In the other case aspiration and instillation of Penicillin gave very good results. One had two courses of Penicillin and developed empyema necessitans and was drained and local Penicillin instilled.

Method of instillation:—30 to 40 thousand units are dissolved in 30 to 40 c.c. of normal saline and injected into the cavity after aspiration or draining of the abscess.



# LUNG ABSCESES

Nationality, sex and age.	Date of admission	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks
1. H.M. 47	11-9-44		Lung abscess 9 months.	22-12—Sputum culture—pneumococcus, streptococcus, staphylococcus grown, clinical and X-Ray evidence of abscess lung on the right side. 15-1—Sputum culture—strepto staphylo RBC —2-45—m. WBC 18,800 HB—55% X-Ray shows abscess lung on left side.	History of pneumonia in 1944. 25 days later developed pain in the right side of the chest bringing out blood stained sputum.  History of a motor accident in June 1944. 25 days later developed pain in left chest Clinically and radiologically evidence of abscess on the left side. Cough bringing out sputum and temperature in evenings.	30-12—100,000 units of Penicillin intramuscularly every three hours. 16-1-45 do. 260,000 units. 15-2-45—locally through Bronchoscope 60,000 units.  Prior to Bronchoscopic instillation patient had deep X-Ray therapy in the Barnard Institute and intramuscular Penicillin 18-1—189,000 units 10,000 units every four hours. 14-2—50,000 units in 10 cc. normal saline through a Bronchoscope 27-3—30,000 units through Bronchoscope 5-4—do. Two more instillations in the month of May. Two courses of Penicillin 15,000 units per dose. Total dose 540,000 units used 1-1-45 and 14-1-45.	There is definite improvement with regard to general condition.  The case has markedly improved after local instillation of Penicillin through the Bronchoscope and the last X-Ray taken on 5-7-45 shows the almost disappearance of the abscess cavity. The general condition of the patient has markedly improved.
3. H.F. 28	22-12-44	17-1-45	Lung abscess	Sputum cultures 30-12—Pneumo 5-1 do. 9-1 do. 16-1 do. RBC-4 millions WBC 9,000 No TB bacilli seen in sputum X-Ray right upper lobe cavity positive.	Fever, cough and expectoration since 1½ months.		There was no improvement but local penicillin was not used.
4. H.M. 30 years.	9-2-45.		Lung abscess 3 months.	Sputum culture streptococcus staphylococcus.	History of having recovered from Pneumonia, later developing fever and cough and bringing out 'foul smelling sputum.	Had previously Cibazol, no effect. 40 tablets given. 7-8—Penicillin 1,00,000 units given 10,000 units parenterally every three hours. 7-8, 1,00,000 units. 18-8 1,00,000 units. 24-8 3,00,000 units. 10-9 2,00,000 units. 29-3 30,000 units. through bronchoscope 17-4 do. 8-5 do. 7-6 do. 7-8 do. 13-9 do.	Patient still in the ward.

S. H.M. 55.	20-3-45.	12-6-45.	Lung abscess 2 weeks.	3-4-45—Sputum culture —strepto and staphylo grown. 21-5—Sputum culture for T.B. negative after 6 weeks.	Started 2 weeks ago with fever and cough bringing out frothy sputum which is foul smelling. Other systems nil abnormal. Clinically & radiologically there is evidence of abscess cavity of right lung.	In addition to the usual treatment, Penicillin was given starting on 2-4-45, 2,00,000 units intramuscularly in the usual way. In addition had instillation of Penicillin through Bronchoscope 30,000 units each, once in 2 weeks 3 times, 8-5, 22-5, 5-6.	Patient discharged for want of beds and asked to come after a week. At the time of discharge, X-Ray shows reduction in the size of cavity considerably and leading to fibrosis.
H.M. 36.	14-2-35.	13-9-45.	Lung abscess 1 year.	2-8—Sputum staphylo strepto grown. No T.B. bacilli. 15-8—WBC 7200 X-Ray dense opacity opposite 2nd and 3rd ribs continuously spreading from the heart shadow about the level of ascending aorta. No fluid level is seen	Duration 1 year complaining of cough and pain in chest. Little blood in sputum. Going down in weight. Clinically an area of dullness near the right lateral sternal line which appears to be continuous in between 3rd and 5th spaces Bronchial breathing over that area.	2 courses of Penicillin, one 3,00,000 units on 23-8-45 and another on 11-9-45 and 3,00,000 units parenteral administration.	There is improvement in the general health and the opacity is getting smaller.

The treatment of lung abscesses has been a problem. The mortality rate has remained high, which becomes evident from the statistics presented below. It shows our helplessness in the treatment of this condition. Various types of treatment have been advocated from time to time with dramatic results in some and with poor results in the majority of the cases. Since the advent of Penicillin and its use in the treatment of this condition, it is giving the medical man a new ray of hope. Local instillations of Penicillin through a Bronchoscope is showing good results and is advantageous. Lung abscess is usually the result of obstruction to one of the branches of the bronchus causing atelectasis of the lung and subsequent development of infection and formation of abscess and reaction of tissue until it is cured by fibrous tissue formation. Intramuscular injections of Penicillin in cases who have remained for a long time as a closed abscess will have no effect as fibrous tissue forms a barrier for the action of Penicillin. A Bronchoscope helps both the drainage of cavity and instillation of Penicillin in the cavity. The instillations are done at long or short intervals 30 to 40 thousand units in 5 to 10 c.c. of normal saline according to the condition of the abscess ulcers are checked by X-Ray appearances, local examination and improvement in general condition.

abscesses were treated one of which came in an advanced state and was discharged otherwise and subsequently it was learnt that the patient died. The others died remarkably and are progressing towards cure and one can be stated to be a complete cure. This illustrates that abscesses with thick walls do not respond to intramuscular Penicillin and once the drainage is done through Bronchoscope and growth of bacteria controlled by Penicillin therapy the reaction is rapid and cure.

METHOD OF ADMINISTRATION: The Bronchoscope is passed under general anesthesia once in 10 to 20 or 30 days and aspiration of the pus by the suction apparatus is done and 30 to 40 thousand units of Penicillin 5 to 10 c.c. of normal saline is injected by the long bronchial syringe.

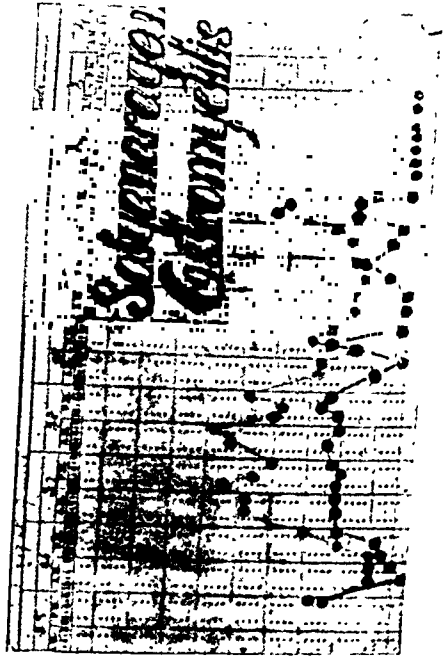
The cases were treated by Dr. Kutumbiah, Dr. Arunachalam and Dr. K. C. Paul and the Bronchoscopic work was done by Dr. M. N. Prabhu.

YEAR	STATISTICS OF CASES OF LUNG ABSCESS.			
	CURED	RELIEVED	DISCHARGED	TOTAL
	OTHERWISE			
1941	3	11	13	32
1942	3	9	5	22
1943	3	6	5	18
1944	1	5	3	15
1945	5	—	—	6

# OSTEOMYELITIS

Nationality, sex and age	Date of admission	Date of discharge	Diagnosis	Investigations	Signs & Symptoms	Treatment	Special features of the case and remarks
1. H. M. 23	23-6-45	21-7-45	Brodies Abscess upper end of right femur.	Urine nil abnormal Kahn negative.	Pain in the right thigh duration 6 days, slight lateral rotation of right limb. Diffused swelling on the lateral aspect of right thigh. X-Ray showed Brodies abscess with sclerosis.	Operated 25-6-45 and abscess cavity laid open and 30,000 units of Penicillin instilled. Wound closed and put in plaster. Later parenteral administration of 500,000 units given, wound healed and by first intention.	Patient was discharged cured.
2. H. Fe. 10.	16-4-45.	9-9-45.	Osteomyelitis, right femur, pathological fracture 1 month.	X-Ray fracture lower end of the femur seen.	The trouble started one month previously in the lower part of the right thigh which was incised. As it was not draining properly incised once again in the lower part. Later she was moving the leg and immediately she was brought to Madras for treatment.	17-4-45—Incision on the right thigh in its lower part made and abscess drained and the limb was put in Thomas splint. Penicillin started 300,000 units given.	Patient made an uneventful recovery. Fracture united and rehabilitation treatment being done: 18-2-45 has reported with a small SINUS X-Ray shows a small sequestrum otherwise quite alright.
3. H. M. 12	17-4-45.	14-8-45.	Osteomyelitis lower end of Femur 2 years.	Urine nil abnormal. Kahn-negative X-Ray-sequestrum seen.	Came for discharging sinus in the lower end of thigh on lateral aspect. History of small bone piece coming out now and then. Bone thickened and tenderness present over lower aspect of thigh.	25-6-45—Operated wound sutured with a separate drain in the dependent part. Put in plaster. 23-6—As temperature was high and persistent, Penicillin started 20,000 units per dose, 700,000 units given.	After Penicillin temperature came down promptly and later had an uneventful recovery.

TEMPERATURE AND PULSE CHART OF CASE No. 3.



4. H. F. 11	15-2-45.	10-3-45.	Acute osteomyelitis with sequestrum formation.	X - Ray - osteomyelitis with sequestrum formation.	History of severe fever with delirium and swelling of right leg. Treated by Penicillin, intravenous by a private doctor after which she recovered. Total 500,000 units given. At the time of admission she came with persistent sinus in the lower part of the leg on the medical side.	Sequestrotomy done and the wound was sutured and drained separately in dependent part. Limb put in plaster.	Penicillin helped in saving the life of the patient in the acute stage and helped localisation of the disease.
5. H. M. 10	23-7-45.		Chronic osteomyelitis one year.	Urine - nil abnormal Blood-WR negative X-ray dullness present - periosteal, thickening of Tibia and to a less extent of fibula.	Started with fever and swelling of leg 1 year ago. Healed sinus over the right leg. Another sinus adherent to bone underneath Tibia on the left leg discharging pus near the middle and lower third with some granulations. Another sinus near left knee discharging pus. 10/8-Tender painful swelling warm over left leg in the lower part. Warm to touch.	10/7-Started on Penicillin 20,000 units every three hours. Total dose 300,000 units given. Lot of discharge of pus, and the pain and swelling came down. 27/8-Another course of 300,000 units followed by lot of pus.	Sinus showing signs of healing.
H. F. Ch. 6.	16-8-45.	3-9-45.	Osteomyelitis Ilium.	Urine - nil abnormal X-Ray--areas of rarefaction is visualised in the left Ilium.	Pain and swelling in the left hip duration 1 month swelling of the right thigh, extends in the upper and middle third of thigh. Extremely tender. Warm. Movements of hip joint free.	16-8-Penicillin 300,000 units given 15,000 units every 3 hrs. 18-8-Abscess on left side drained limb put in Thomas splint.	Under observation. Sent home in plaster spica. Bone was not drained but the abscess pointing in soft tissues drained. Awaiting to see the sequelae of the treatment.

# OSTEOMYELITIS—(Contd.)

ationality, x and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
H. F. 35.	16-11-45.	20-11-45.	Septic arthritis, knee left.	Urine—no sugar, no al- bumin, pus from the left knee streptococci grown.	One month back patient had fever with rigors and 4 days swelling in left knee joint. She had fleeting attack of all other joints but subsided and ultimately settled in left knee joint. She was given 4,00,000 units of Penicillin 15,000 units every 6 hours, the temperature has come down swelling of the left knee re- mained as it was. On ad- mission left knee fusiform swelling, fluctuant and pain- ful, no movement of the joint possible.	11-11-45—Joint has been as- pirated, 6 oz. of pus removed and sent for culture. 30,000 units of Penicillin put in I.M. penicillin 15,000 units started every three hours, 140 000 units. 12-11—Penicillin 30,000 units was put in the joint after aspiration. 13-11—60,000 units put in after aspiration of pus. Very little pus has come. Swell- ing of the joint is much less. 16-11—30 000 units of Peni- cillin was put in. 20-11—Swelling of the knee is much less. No pain. Limb put in plaster discharged.	The septic arthritis of the knee responded only after local instillation of Penicil- lin. 18-2-45—Patient has im- proved in health and has gained 45° movement from straight line.

In acute osteomyelitis, the acuteness of the infection is definitely controlled by the administration of Penicillin but unfortunately when the Surgeons see the cases, the abscess has already burst with greater area of infection of bone.

A child aged 7 years came to the hospital with a history of pain in the region of the left thigh with a swelling along the direction of the rectus femoris. This child had an abscess of the left shoulder. On X-Ray examination it was found there was rarefaction of the ilium though the temperature was not severe. The patient was diagnosed to be a case of hip joint disease outside, but on careful examination the hip joint was found free. It was peculiar that the child did not complain of any pain in the region of the ilium but all pain was referred to the region of the hip which was flexed. There was a distinct swelling in the upper part of the thigh more laterally.

She was given Penicillin. Her general condition improved and the abscess was drained and then subsequently administration of Penicillin was continued until her temperature reached normal and was put in plaster of Paris and sent home for convalescence and she is still under observation. This illustrates that preliminary administration of Penicillin controls the temperature and toxicity due to the activity of the germs by its bacteriostatic action and if subsequent drainage of the abscess is undertaken the convalescence is to a great extent accelerated. It is no use persevering with Penicillin if the abscess cavity is too large. The abscess has to be drained and for the Penicillin to work better, or should be continued till the temperature reaches normal. The X-Rays of the case cited above show the peculiar striated rarefaction and is very interesting as the text books state that osteomyelitis of the ilium is a grave infection in children. In this case, the effect of the Penicillin treatment is watched to see whether the case is going to recover completely without any sequestrum as no operation on bone has been undertaken.

In cases of chronic osteomyelitis, Penicillin has been used after sequestromy to combat the alarming reaction that followed the operative interference. It definitely helped to control the infection and has helped recovery. A case of Brodies Abscess is worthy of note. A dramatic result has occurred in this case. The abscess was drained completely after saucerisation, dried and closed by stitching the muscles to make it water tight. 30,000 units of Penicillin was injected into the cavity. Later the limb was immobilised in plaster spica. The wound healed by first intention though there was a little general reaction after the operation. Penicillin was continued intramuscularly at intervals of three hours. The only post operative complications was insomnia, due to the morphia habit which he had contracted to relieve him from pain prior to the operative procedure. It took some time to wean him from this habit. Ultimately he was discharged cured at the end of 29 days, wound healing by first intention.

## COMPOUND FRACTURES

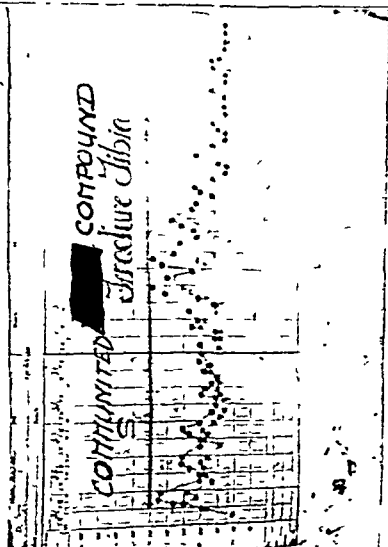
Nationality, age and sex	Date of admission	Date of discharge	Diagnosis	Investigations	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H M. 40.	18-1-1945.	30-1-45.	Compound comminuted fracture right leg both bones.	Bac. report culture from a small bit staphylo strepto B. Coll grown.	Alleged to have been hit by wheel of a motor launch on the right leg. Patient was brought back in a very bad state of shock.	A T.S. A.C.S given 4 bottles of plasma, given to rally him round. Wound was cleansed, debridement done in the theatre and put in plaster 3,00,000 units Penicillin given, 15,000 units every 3 hours.	Infection was controlled and the general condition improved after Penicillin. But the patient died of intractable diarrhoea.
2. H M. 45.	21-3-45	27-5-45.	Compound comminuted fracture left leg.	X-Ray fracture of lower end of tibia and Fibula.	Motor accident knocked down patient. Wound on left leg 5" x 3" on the medial aspect present.	Operated in the theatre. Wound cleaned and the debridement done and 24 tablets of Cibazol given and four ampoules of soluseptasene given. But still temperature was not controlled. On 29-3-45 Penicillin started 4,00,000 units given in the usual way.	Sulfa resistant temperature promptly came down and patient recovered later.

COMPOUND FRACTURE CASE No. 2.

COMPOUND FRACTURE OF TIBIA

Pulse and temperature chart.

COMPOUND FRACTURE CASE No. 2.



**Pulse and temperature chart.**

# COMPOUND FRACTURES—(Contd.)

<i>Nationality, sex and age.</i>	<i>Date of admission.</i>	<i>Date of discharge.</i>	<i>Diagnosis.</i>	<i>Investigations.</i>	<i>Signs &amp; symptoms.</i>	<i>Treatment.</i>	<i>Special features of the case and remarks.</i>
3. H.M. 50.	17-7-45.	31-8-45.	Compound com- munit supra- condylar left humerus.	X-Ray compound com- munit fracture su- pracondylar region.	History of the elbow being jammed between two trucks resulting in compound, com- munit and complicated condition involving elbow joint through the olecranon.	17-7—Under anaesthesia the wound debrided and ulnar nerve which was intact pro- tected and loose fragments removed; powdered with strep- tocidine and put in plaster. Started parenteral penicillin 4,00,000 units, 6-8 Under local pin was inserted. 25-8—Pin removed and put in plaster.	Temperature was normal from 2nd day and Penicillin prevented spread of infec- tion; the result is very good.

Penicillin has a definite place in the treatment of compound injuries. Unfortunately, due to the smallness of the stock and its costliness, local application has not been tried but intramuscular administration has given dramatic results but it must be used only after the employment of the debridement technique. Primary suture was done with or without drainage and when drainage is done it must be in the most dependent part through a separate stab drain and not on the line of incision. It is impressed that Penicillin has no value unless the debridement is complete.

# SYPHILIS

<i>Nationality, sex and age.</i>	<i>Date of admission.</i>	<i>Date of discharge.</i>	<i>Diagnosis.</i>	<i>Investigations.</i>	<i>Signs &amp; symptoms.</i>	<i>Treatment.</i>	<i>Special features of the case and remarks.</i>
1. H.M. 21.	14-4-45.	21-4-45.	Primary Syphilis.	Dark ground examina- tion T. pallida found in large numbers, Blood- Kahn-positive. W. R. positive, Urine-nil particular.	Duration, 15 days. An in- durated ulcer in the right lateral aspect of the prepuce Glands both groins enlarged, discrete, painless and hard. No secondary rash. No dis- charge per urethra. History of exposure 1 month back.	14-4—Penicillin commenced 25,000 units per dose for 8 days. Total dose 1,200,000 units given.	<ol style="list-style-type: none"> <li>1. After the 1st infection he had typical Hensen Heimer re- action, i.e. exacerbation of symptoms with rise of tem- perature up to 100° F. which subsided later.</li> <li>2. Spirocheta pallida, dis- appeared from the lesion on 10½ hours.</li> <li>3. Ulcer healed in 7 days.</li> <li>4. W.E. Kahn negative on 30th April, 1945; 10th July, 1945 and 23rd August, 1945.</li> <li>5. No rash, no clinical re- lapse up to date. Case re- acted well to Penicillin.</li> </ol>

One case was treated and the findings are the same as those of the Mahoney Committee. The case is under observation to know the effects of Penicillin with regard to the cure of this condition by periodical serological and clinical tests.



# GONORRHOEA—ACUTE

Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.M. 37.	1-6-45. O.P.		Acute Gonorrhoea 20 days.	Urine, hazy; Gonococci positive; pus cells positive; Secondary organisms positive.	Discharge through urethra. Burning sensation present. duration 20 days.	1/6—200,000 units Penicillin intramuscularly, 20,000 units per dose every three hours.	There is much improvement in relief of symptoms 10 days after the course. GONOCOCCI are seen in urine.
2. H.M. 30.	7-8-45.		Acute 3 months	Do.	Discharge per urethra present. Burning sensation. duration 3 months.	13/5—200,000 units intramuscularly 20,000 units per dose every three hours.	17-5—Improved well after treatment but did not report later.
3. H.M. 44.	15-5-45.		Acute Gonorrhoea with arthritis both ankles duration 1 wk.	Urine-Gonococci positive, pus cells positive.	Swellings of both ankles present with pain. Discharge per urethra, burning sensation.	19/3 Sulfathiazol tablets 36 in 3 days given with no benefit. Gonococci in urine disappeared. But pus cells are present.	16-4—No definite organisms in urine. Few epithelial cells seen. Clinically improvement noticed, joint swelling disappeared completely.
4. H.F. 20.	26-6-45.	A	Acute Gonorrhoea with acute arthritis of small joints, right foot, 2 weeks.	Urethral smear Gonococci positive—pus cells positive.	Oedema of right foot and active and passive movements of right foot painful. Bead of pus seen at urethral meatus.	26-6—300,000 units Penicillin given every three hours.	She was able to walk about. No gonococci seen.
5. H.M. 25.	25-4-45.		Acute Gonorrhoea, one week.	Urine—Gonococci positive, pus cells positive, no secondary organisms.	There is purulent discharge from the urethra for 1 week	26-5—200,000 units of Penicillin, 20,000 units every three hours, intramuscularly.	11-7—Patient is alright. Oedema is subsided. This case reacted well to Penicillin.
6. H.M. 24.	13-2-45.		" 1 month.	Urine hazy Gonococci positive, pus cells positive.	Profuse discharge present. Burning sensation.	Had 72 tablets of sulfanilamide, still Gonococci present.	Urine became clear after treatment. No discharge.
7. H.M. 24.	17-7-45.		" 1 week.	"	Pouring discharge per urethra. Burning sensation.	30-3—100,000 units of Penicillin given, 20,000 units every 3 hours.	1-6—Urine No Gonococci seen. This case is cured.
						18-7—200,000 units of Penicillin 20,000 units every 3 hours intramuscularly.	Urine clear. No Gonococci seen after Penicillin.
							9-4—Urine clear, no pus cells or organisms.
							5-6—do. do. case cured.
							2-8—No discharge Prostatic massage negative.
							6-8—do. do. case cured.

7 cases of acute Gonorrhoea were treated. An average dose of 200,000 units of Penicillin was given. Two cases were definitely sulfa-resistant. In one case Gonococcus was definitely seen in the urine after 10 days of the course though the immediate relief was good. The one case that improved could not be followed up. Of the 7 cases, 4 were cured, 2 of which definitely sulfa-resistant and in one case there was arthritis of the small joints of the feet.

# GONORRHOEA—CHRONIC

<i>Nationality, sex and age.</i>	<i>Date of admission.</i>	<i>Date of discharge.</i>	<i>Diagnosis.</i>	<i>Investigations.</i>	<i>Signs &amp; symptoms.</i>	<i>Treatment.</i>	<i>Special features of the case and remarks.</i>
1. H.M. 24.	26-2-1945.		Chronic. Gonorrhoea 3 years.	Urine—no tubercle bacilli Culture—B. coli grown. Smear—pus cells positive. Second- ary organisms posi- tive. No definite Gonococci.	Marked severe strangury. Tender prostate.	Had 50 tablets of Cibazol, no improvement. 20/2, 100,000 units every three hours given intramuscularly.	Urine was clear for a few days but relapsed after 10 days. No benefit with Peni- cillin.
2. H.M. 27.	31-3-1945.		Chronic Gonorrhoea 20 days' duration.	Urine—pus cells positive Gonococci positive. Secondary organisms positive. Culture—B. coli grown.	Discharge scanty and burn- ing sensation present.	Had two courses of sulfad- iazine 40 tab. each time, no benefit, two injections of T. A. B., no benefit. Had 3 courses of Penicillin: 31/3—100,000 units 14/4—200,000 units 14/6—200,000 units in the usual way.	After each course urine be- comes clear but within about a week comes to original state. At the end culture of urine showed B coli, no benefit with Penicillin.
M.M. 40.	16-4-45.		Chronic Gonorrhoea 3 years.	Urine Gonococci posi- tive, pus cells positive. Secondary organisms positive.	Discharge severe and burn- ing sensation present.	Had 42 tablets of Cibazol. No Gonococci seen after that but pus cells present. Dis- charge present 16/4—200,000 units Penicillin 20,000 units every 3 hours.	No discharge after treat- ment. Urine clear and smear negative. The case was cured.

All the above three cases were sulfa-resistant. One of these definitely reacted to treatment and the other two were not successful. I am thankful to Dr. Natesan for providing the information given above.

# CELLULITIS

Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.M. 30.	16-12-44.	20-12-44.	Cellulitis nose and face 4 days.	Urine alkaline Sp. Gravity 1010. No albumin, no sugar, no pus cells. Blood—No M.P. Total WBC—6,800. Poly 85% Lymp 7% Mono 8% Blood culture. No growth Nasal swab streptococcus seen in smear. 18-12-44—Blood culture negative. Nasal swab, pneumococci.	History of swelling started 4 days back at the tip of the nose. It gradually increased.	Had already 19 gms. of sulfa drugs, but improvement. 16-12-44—2 p.m. Penicillin parenteral intramuscular 15,000 units per dose every 3 hours started. Total dose 145,000 units.	Sulfa resistant case reacted very well to Penicillin. After the first injection headache became less. After the third, pain disappeared definitely. After the sixth patient felt completely better. 18-12-44—Swelling of nose much reduced. There was slight discharge of pus. 19-12—Swelling of nose disappeared. Colour of skin normal. 20-12—discharged cured.
2. H.M. 30.	27-4-45.	15-5-45.	Cellulitis foot and septicaemia 2 weeks.	Urine nil, abnormal. Blood picture Leucocytes. No M.P. Blood culture on both occasions negative.	History started after thorn prick 2 weeks ago which was removed. Left foot and ankle and leg swollen, tender, painful incised wounds on either side of heel present. General condition: high temperature 103 and toxic.	1. Clibazol by mouth 28 tabs or 14 gms., soluseptasine 5 amps. up to 3-5-45 from day of admission. 4-5—Penicillin 15,000 units every 3 hours, intramuscularly total 480,000 units.	In spite of Sulfa drugs, patient was not at all improving and condition was deteriorating. After Penicillin was given, patient made rapid recovery and discharged cured eleven days after treatment was started.

Temperature and pulse chart.



CELLULITIS CASE No. 2.

The case responded very well and has been averted from the danger of cavernous sinus thrombosis.

Daily insulin after estimating sugar. Total 400,000 units Penicillin, 15,000 units every 3 hours 18 tablets of streptocide were given after Penicillin was stopped.

Swelling of the left side of the face extending up to the eye left eye closed and mouth could not be opened. Lot of induration, pain tenderness and the whole area was red.

Urine—Sugar plus acetone—plus.

face

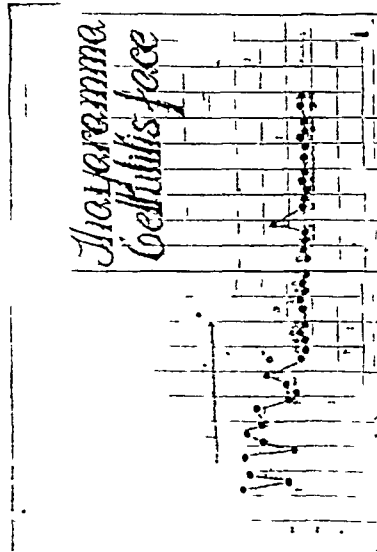
Cellulitis 4 days

13-6-45

4-6-45

3 H.T. 65

Temperature and pulse chart.



Clinical photograph after treatment.



Clinical photograph before treatment.

# CELLULITIS—(Contd.)

Nationality, sex and age.	Date of admission	Date of discharge	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
4. H.F. 30.	13-2-45.	22-3-45.	Cellulitis face 4 days.	Urine nil, abnormal.	4 days duration started with headache, later swelling of the face extending down to neck also.	13-8—Patient unconscious, pulse feeble, volume and tension poor, condition of the patient unsatisfactory. Glucose 10 c.c. Coramine 1 amp. Penicillin 300,000 units, 15,000 units every 3 hours.	19-8—Patient conscious and cheerful. Penicillin continued. 20-8—Swelling of face gone down considerably, general condition better. 22-8—Discharged cured.
5. H.M. 40.	8-9-45.		Orbital Cellulitis right eye.	Clinical photo taken.	Right eye marked proptosis, chemosis and œdema, lids. Ran a hectic temperature 2 days prior to Penicillin the- rapy. Angry looking swelling over the eyelid. Fluctuation present, markedly tender.	400,000 units of Penicillin in- tramuscularly and 20,000 units 2 c.c. every 3 hours, deep in orbit through opening through which drainage was effected.	Temperature touched normal on 13-9-45—All œdema from upper eyelid disap- peared and also from the opposite eye. Chemosis less, slight discharge of pus from the opening. Drainage effec- ted. Temp. could not be controlled with sulfa injec- tions. All acute symptoms of pain & swelling disap- peared after penicillin.
6. H.M. 21.	29-9-45.		Cellulitis Lip		1 month not keeping good health. Since 2 days had small ulcers on the tongue and lips. Later swelling on lips increased and therefore admitted.	29-9—Started on penicillin 20,000 units per dose. Total 400,000 units. Also penta- neucleotide 3 injections given.	Patient died.

Results of treatment of cellulitis, especially of facial cellulitis has been very excellent. Prior to the advent of Penicillin severe cases of this type ended in cavernous sinus thrombosis meningitis, encephalitis and death. Penicillin has altered the picture. Majority of the cases of cellulitis, severe or mild, reacted to Penicillin and the response has been dramatic.

Four cases of cellulitis of the face one case of orbital cellulitis and one of foot were treated. Excepting the case of a doctor, all the other facial cellulitis were serious and would have ended in cavernous sinus thrombosis had they not been treated with Penicillin. All the cases were sulfa-resistant. Three cases were discharged 13 days after the treatment with Penicillin was commenced (average period). One case died.

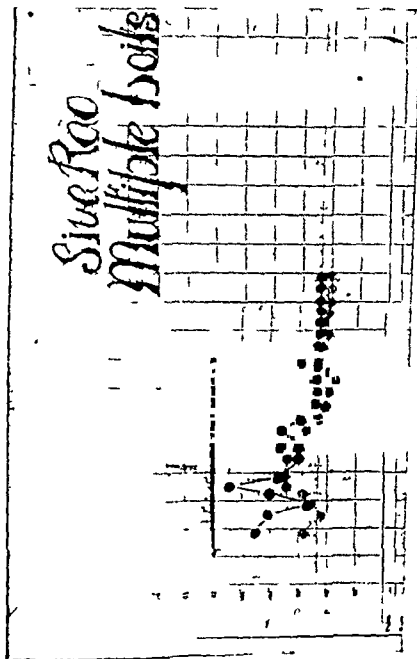
# PYÆMIC ABSCESS

<i>Nationality, sex and age.</i>	<i>Date of admission.</i>	<i>Date of discharge.</i>	<i>Diagnosis.</i>	<i>Investigations.</i>	<i>Signs &amp; symptoms.</i>	<i>Treatment.</i>	<i>Special features of the case and remarks.</i>
1. H.M. 35.	22-10-44.	21-2-45.	Pyæmic abscess 1 week.	29-1-45—Blood culture— Staphylo-strepto non- hemolytic grown. 10-2—Blood culture no growth.	Multiple abscesses all over the body. Abscess of right thigh, left gluteal region and on the arm.	Had large doses of Clbazol by mouth. Abscesses have been incised and drained. 2-2-45—Penicillin 300,000 units in the usual way.	This is a remarkable case where the use of sulfa drugs and surgical treatment, the patient did not improve and blood culture, after all the above has been positive. Later cured by Penicillin.
2. M.Mc. 0.	28-3-45.	12-4-45.	Pyæmic abscess.	Urine nil particular Blood culture-31-3-45— Staphylococci grown. 11-4—no growth.	History of being pulled from the road by the hand sud- denly 15 days back and later developing fever and inability to flex left elbow with a pointed swelling behind left elbow and another over right hip. X-Ray nil, abnormal.	I—Icthyol Glycerine bandage to the elbow and hip. 11—500,000 units of Penicillin intravenously, 15,000 units every three hours.	Penicillin has cured the con- dition and he got back all the movements of elbow and hip by the time he was dis- charged.
3 A.I.Mc. 2	4-5-45.	6-5-45	Pyæmic abscess one week.	Urine nil particular.	Multiple abscesses all over the body. The boy had taken Clbazol but had to stop it as he developed rash.	Penicillin 200,000 units was given, 15,000 units every 3 hours.	Where sulfa group of drugs did not agree, Penicillin proved useful.

# PYÆMIC ABSCESS—(Contd.)

Nationality, sex and age.	Date of admission	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
4. H M '15.	13-7-45.	19-7-45.	Multiple boils 2 weeks.	Urine nil particular.	Multiple boils throughout the body 2 weeks duration.	1. Had Cibazol in his house. 2. Penicillin 400,000 units every three hours.	Sulfa resistant Responded to Penicillin.
5. H M. 20.	18-9-45.		Septicæmia Pyæmic abscess 5 days duration.		5 days back started with fever and swelling, pain which increased day by day. At the time of admission the patient was very toxic, Fluctuant swelling on the lateral aspect of right thigh.	18-9—Abscess opened and drained. Lot of pus came. Penicillin started, 20,000 units every 3 hours. After first 400,000 units were given, temperature was controlled and subsequently developed another abscess in the right side of the back. Another 400,000 units of Penicillin was given which controlled fever and swelling disappeared.	Discharged cured.

Temperature and pulse chart of Case No. 4.



G. H.Mc. 2.	17-10-15.	22-10-45.	Pyæmic abscess.	Urine-nil particular 18-10—Blood culture negative.	Multiple abscesses since 15 days. 1. An abscess about the size of an almond in the upper part of back of chest on the left side. 2. Another abscess on right side of neck. 3. Two abscesses burst one in left side back of hand and one on the abdomen.	17-10—Abscesses incised and drained. Started on penicil- lin. Total 200,000 units given, 15,000 units every 3 hours.	
7. H. M. 21.	18-9-45.	23-10-15.	Pyæmic abscess.	Urine-nil abnormal. Blood culture negative. Pus culture-staphylo- coccus grown.	5 days duration. Two ab- scesses one on the buttock over the left side 4" in dia- meter and one in the thigh.	20-9—Abscesses were drained after incision. Even after 49 tabs of Cibazol no improve- ment in general condition. 400,000 units of Penicillin, 20,000 units every 3 hrs. was given. Patient improved for some time and developed an- other abscess on the thigh with rise of temperature on 10-10-45. Another course of 400,000 units of penicillin given after incising the ab- scess after which patient was discharged cured.	Even after Cibazol and drain- age of the abscesses patient did not improve and Peni- cillin had to be given, after which the patient recovered well but subsequently deve- loped another abscess which necessitated the repetition of Penicillin.
B H M. 30.	2-11-45.		Pyæmic abscesses multi- ple abscesses.	Urine-nil abnormal. Pus culture-staphylo- cocal grown. 4. 11-455. WBC—4,200.	Multiple abscesses are seen over the following regions— (1) right neck, (2) right thigh & gluteal region, (3) left axilla.	3-11—Incised & drained and put on Cibazol 6 tabs a day. 15-11—Another abscess incised and drained on right knee joint extra articular. Till 20-11-45 87 tabs of Cibazol were given. The patient's condition did not improve much and so Penicillin was started on 21-11-45. Total 300,000 units, 15,000 units every 3 hours were given after which the general condition improved remarkably.	A case resistant to sulpha- thiazole reacted to Penicillin.

In cases of Pyæmia, the results are dramatic—8 cases were treated with Penicillin. But for Penicillin the period of illness would have been prolonged and in some cases ended fatally. In one case many abscesses were opened until at last Penicillin was used with dramatic results. In cases of Pyæmia, due to staphylo or streptococcus, Penicillin gives dramatic results.



# SKIN CASES—FURUNCULOSIS

Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.M. 35	12-7-45.	16-7-45.	Furunculosis one week.		Boils above the neck and on head. No gland is enlarged.	100,000 units of Penicillin every 3 hrs.	Result good.
2. H.M. 24.	20-6-45.	23-6-45.	" 1 month.		History of the furuncles appearing now and then and disappearing after Cibazol treatment and reappearing after some time Multiple furunculosis present over the forehead on the face over the cheeks, some behind the ears, on the forearm, raised above the surface, swelling of face below eyelids, no fever	100 000 units of Penicillin every 3 hrs.	General condition improved; furuncles disappeared over the cheek. Definite improvement noticed.
1. H.M. 13.	12-7-45.		Bockharts Impetigo one year.		Folliculitis present in the external aspect of both legs with raised particles at the hair follicles. Irritation & burning sensation present.	200,000 units Penicillin, 20,000 units every 3 hours.	Improved.
2 H.M. 25.	26-6-45.	30-6-45.	"		Present in the external aspect of leg and inner aspect of right thigh.	100,000 units, 20,000 units a dose.	Little improvement.
3. H.M. 60.	11-6-45.	23-6-45.	Impetigo & toxæmia.		Generalised impetigo present all over lower extremities, gluteal region and back. Patient's general condition bad and anæmic.	100,000 units of penicillin at 20,000 units per dose.	General condition improved considerably. Burning and itching sensation stopped completely. Lesions have dried remarkably but not disappeared altogether.

## (II) IMPETIGO.

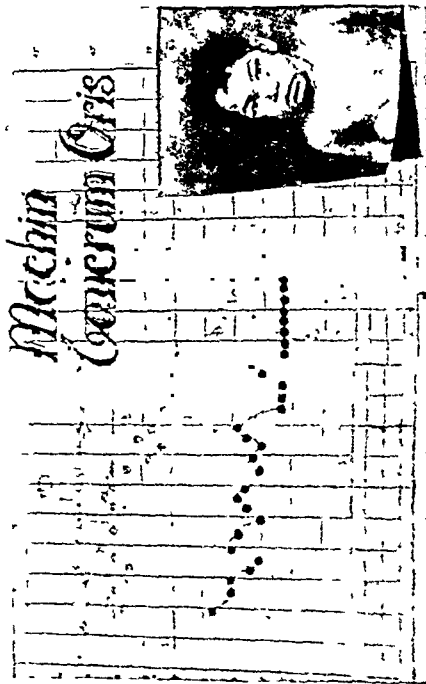
Penicillin has also been used in other cases such as Folliculitis, Allergic Dermatitis, Sycosis and very severe types of Pemphigus, dose given being 100,000 units in 5 injections. No extraordinary improvement was noted in these cases. In cases of Furunculosis the results are satisfactory.

Penicillin has been tried in cases of Impetigo but the results are not very encouraging. (Dr. S. Rajagopalan's experience). The action of Penicillin is the same as the sulfa drugs and cannot claim any better results. More elaborate trials could not be carried out due to difficulty in getting it and also due to its being expensive.

CANCERUM ORIS

Nationality, sex and age.	Date of admission	Date of discharge	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H Mc. B.	27-7-45.	14-8-45	Cancerum oris 5 days duration.	Urine—all particular. Motion—round worm ova seen Diff count —Poly 59%, Lymph. 39%, 26%	Swelling of the face and left cheek and left eyelids. 5 days duration Left cheek: inside a big ulcer 1" x 1" x 1/2" present and black slough in the floor hanging. Patient's general condition very bad Pulse—50/—mt Toxic Liver —3 fingers below costal margin. Spleen palpable.	27th July, 1945 started on penicillin and a total dosage of 400,000 units given 15,000 units every 3 hours, no surgical treatment done.	On the 5th day of admission, temperature came to normal. Slough separated and the floor of the ulcer showing signs of healing, patient taking feeds 14-8—discharged cured. Life undoubtedly saved.

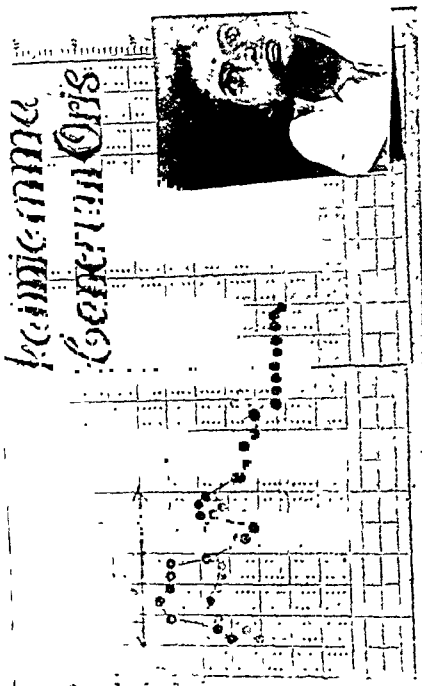
TEMPERATURE AND PULSE CHART OF CASE No. 1.



Inset is a clinical photograph of the case taken during the course of the treatment—Note the swelling of the left cheek.

# CANCERUM ORIS—(Contd.)

Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
2. H.Fc. 2.	17-8-45.	10-9-45.	Cancerum oris 5 days duration.	Urine—nil abnormal.	Started with fever and accompanied by inflammation of the gums. Later patient lost teeth from the pre-maxillary region followed by discharge of pus and blood from the fistula in right nostril just above upper lip. Opening $\frac{1}{2}$ " diameter. Opens into mouth at the level of the pre-molar tooth on the right side. Tenderness positive. No enlarged liver or spleen. General condition on admission restless — fever—pulse—120 per minute. Respiration 40 per minute—toxic.	17/8—Started on penicillin. Total dosage 400,000 units given. Fistulous opening and discharge of pus later disappeared leaving a raw granulating area. Pre-maxilla became necrosed and the necrosed piece fell off as a sequestrum.	Life of the patient undoubtedly saved.
3. H.Fc. 1½ yrs.	9-9-45.	18-9-45.	Cancerum oris 3 days duration.		About 10 days back had fever lasting for 5 days. 3 days back mother noticed swelling of the left cheek. A dark slough involving the left part of the maxilla near the pre-molar region. Indurated swelling of the cheek. Foul smelling odour from mouth.	9/9—Penicillin, 15,000 units every 3 hours. Condys gargle, total dosage of Penicillin 240,000 units.	10/9—Black slough separating and inflammation localized. 11-9—Slough fell off. Patient improved well and discharged 12-9.
4. H.Fc. 12.	14-7-45	8-8-45.	Cancerum oris.	Urine—nil particular. GEL—test positive.	A case of Kala Azar. Tense swelling on the outer aspect of cheek. A history of fever and dysentery since one month. A foul smelling ulcer situated on the inner aspect of the right cheek with a black slough. Patient anemic—general condition low.	18/7—Penicillin 20,000 units every three hours. Condys gargle. Total dosage 300,000 units. Patient given injections of Ureastibamine for Kala Azar.	18/7—General condition far improved. Swelling of the cheek gone down. Slough in the interior of the cheek fallen away. 21/7—Swelling of the cheek gone down. Interior of cheek clean and granulating. Died suddenly.



*Inset is a clinical photograph of the cancerum oris.*

Died suddenly.

S. I.C.Fc. S.	9-10-45.	21-10-45. died.	Cancerum oris.	Swelling of right cheek with pain and tenderness. History of fever since three months. Very anemic, liver and spleen palpable. Hard indurated area of ulcer $\frac{1}{2}$ " diameter inside the cheek at the level of the upper pre-molar with slough in the centre, foul smelling discharge.	Penicillin 300 000 units, 15,000 units every 3 hours intravenously which effectively arrested spreading of the ulcer and later healed. For anemia, polyhaemen tablets and liver extract were given.	Died suddenly.
S. II.Fc. 11.	20-10-45.	22-10-45.	Cancerum oris.	Urine—nil—abnormal. WBC—9000.	20/11—Started on Penicillin. 300,000 units, 15,000 units per dose. 22/11—Patient is much better. Improved very well. 24/11—Gangrenous patch separated off leaving a hole about $\frac{1}{2}$ " diameter.	

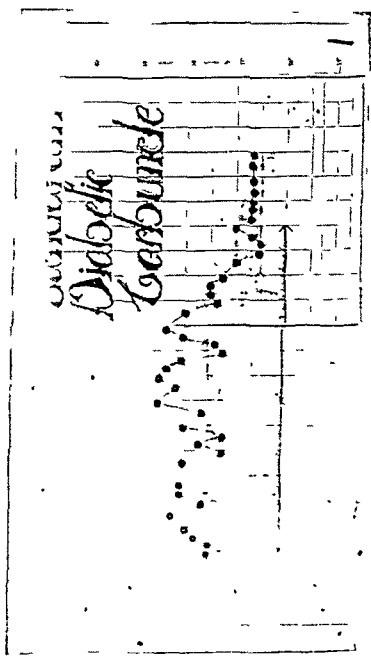
Penicillin has given very satisfactory results in the cases. Out of the six cases treated, results were excellent in four and two died suddenly. Prior to the advent of Penicillin the mortality from Cancerum Oris has been as stated below:—

Year	Cured	Relieved	Discharged	otherwise	Died	Total
1941	—	1	—	—	4	5
1942	—	1	—	—	3	4
1943	—	4	2	—	13	19
1944	—	5	2	—	7	14
1945	4	—	—	—	2	6

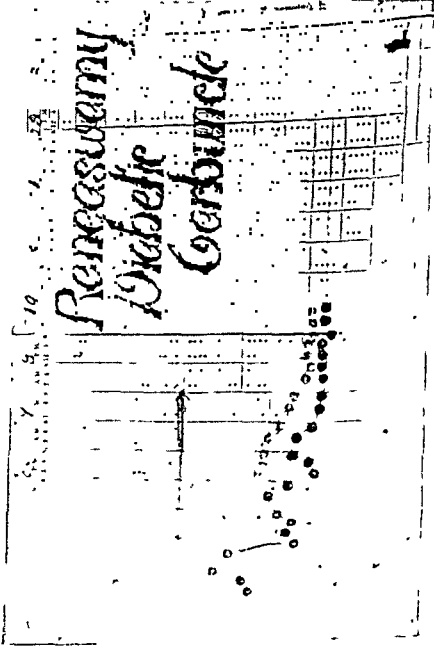
# CARBUNCLES

Nationality, sex and age	Date of admission	Date of discharge	Diagnosis	Investigations.	Signs & Symptoms.	Treatment.	Special features of the case and remarks.
1. H.M. 45.	19-4-45.	1-6-45.	Carbuncle 4 days.	Urine—sugar positive, acetone—positive.	Hard indurated inflammation on the back with multiple sinuses.	20-4—Put on Cibazol and 4 hourly fomentations and Glycerine and Mag. Sulph. 24-4—No improvement. Started. Penicillin 400,000 units given.	25-4—There is definite shrinking in the area of induration. 30-4—The skin is almost normal over the area of induration. Healing took place without operation. 3-10—Reported quite fit.
2. H.M. 40.	14-5-45.	13-6-45.	Carbuncle duration 1 week.	Urine—sugar and acetone positive.	Carbuncle over the nape of the neck measuring 4" x 3". Oedema and induration extending up to the anterior border of sterno mastoid. Complaining of severe and throbbing pain.	14-5—Penicillin 15,000 units every 3 hours. Total 300,000 units. Daily Glycerine and mag. sulph. dressing. 28-5—As a small abscess was pointing it was incised and drained.	By the time he was discharged, the skin came to normal colour and the wound and healed.

Temperature and pulse chart. Case I



Temperature and pulse chart. Case II



Carbuncles resolved nicely which was drained later. Developed Dermatitis which was treated and got better.

Had already 30 tabs of Cibazol. No improvement.  
30-4—Penicillin 15,000 units every 3 hours. Total 400,000 units. Also insulin everyday after examining urine.

Warm indurated swelling size 6" x 4" over right scapular region with multiple sinuses discharging. Had been treated outside for sometime.

Urine—sugar positive, albumin positive and acetone—nil.

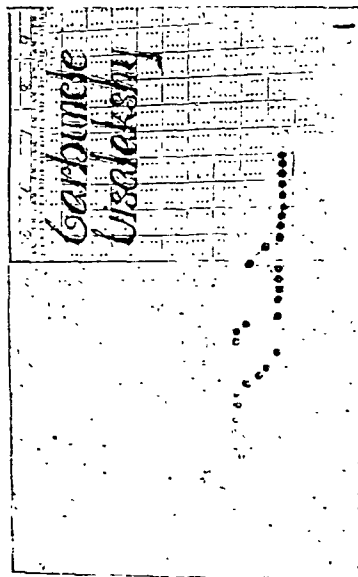
Carbuncle duration 1 week.

27-6-45.

30-4-45

F. 50.

Temperature and pulse chart. Case III



The slough separated and the condition got cured.

Parenteral Penicillin coupled with local injection of Penicillin given. Locally Penicillin was infiltrated around the lesion in a cart-wheel fashion.

Big swelling in between the two shoulder blades on the back with discharging pus.

Urine—sugar positive and Acetone

Diabetic carbuncle.

# CARBUNCLES—(Contd.)

<i>Stationality, sex and age.</i>	<i>Date of admission.</i>	<i>Date of discharge.</i>	<i>Diagnosis.</i>	<i>Investigations.</i>	<i>Signs &amp; symptoms.</i>	<i>Treatment.</i>	<i>Special features of the case and remarks.</i>
H.M. 50.	23-10-45.	30-10-45.	Carbuncle nape of neck, left.	Urine—normal. No sugar. No acetone. No albumin.	Swelling, nape of neck. 15 days back he felt terribly itching at the nape of neck for which he scratched it very badly after which he developed pain and swelling; both increased gradually. Swelling 1½" diameter at the posterior part of the neck on the left side of median line. There were small sinuses, base indurated very painful.	Total intramuscular Penicillin 400,000 units and 200,000 units locally (every day 50,000 units) in a cart-wheel fashion around the swelling. After first injection patient said the pain was remarkably less. The infection got localised and pus was coming out after subsequent injection and ultimately healed.	Remarkable success with local and parenteral administration of penicillin without surgery.

Five cases were treated and the result has been extraordinarily good. In one case, where the carbuncle was big, local infiltration of Penicillin was adopted and the result has been satisfactory though the carbuncle was of a large size and no operative interference was done. Injection was given in the same way as for auto-hemo-therapy and the needles were introduced medially to the infiltrating edge.

# GAS GANGRENE

Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.M. 40.	28-8-45.		Compound fracture both bones forearm left with gas gangrene five days.		History of a fall 5 days back from a bullock cart resulting in compound fracture of both bones of forearm left. Got treated in Puthut, is not better and sought admission here. Local condition: Part below the middle of the left arm is swollen markedly. On pressure, crepitant feel and fluid is oozing from the wound. Smelling very badly. General condition toxic. Pulse 120 per minute, poor volume & tension, respiration 50 per minute.	As the patient's condition was bad no operation was undertaken and was put on Penicillin, 20,000 units every 3 hours. By 4 doses the general condition of the patient improved and under general anaesthesia disarticulation was done. Penicillin was continued. Patient recovered. Total 600,000 units given. Operation was done after giving preliminary injection 200,000 units.	But for Penicillin the patient would have died. The patient's condition improved after administration of Penicillin which enabled operation to be performed and ultimately saved the life of the patient.

# DIABETIC GANGRENE

1. H.M. 45.	30-10-45.	10-11-45.	Diabetic Gangrene right foot.	Urine—Sugar positive. Acetone—Positive. Albumin—traces. Motion—amœba, positive.	Started with swelling 4 days back on right foot. Since 4 days toe has turned dark. Dry gangrene of the IV toe present. Patient's general condition is not good.	Patient was treated for diarrhoea with Emetine and Ciba-zol by mouth for general and local condition. 18-10—Penicillin started, 20,000 units every three hours. 9-11—General condition much better. Lower part of the right leg dusky. Discharged against advice.
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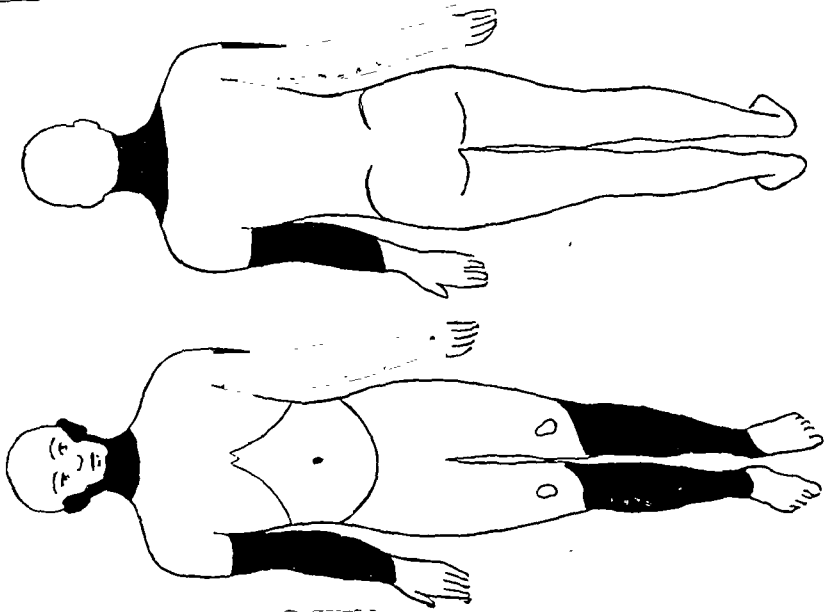


# ULCERS

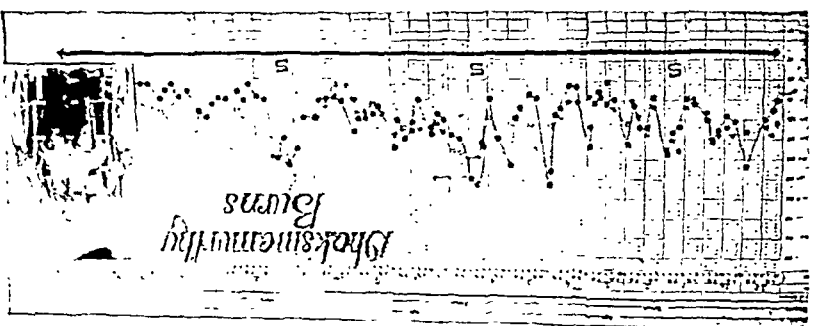
Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis.	Investigations.	Signs & symptoms.	Treatment.	Special features of the case and remarks.
1. H.M. 23.	4-9-45.		Congenital Hydronephrosis left kidney, tropical ulcers on the foot 1 month.		History of itching sensation and after scratching a raw area found which increased in size. Two ulcers on the dorsum of the foot 1" in diameter and the other ½" diameter. Both circular with clean cut edges with white slough in the base. Sur- rounding tissues indurated with severe pain, spending sleepless nights.	Local cillin every day about 2,000 units in 2 cc. of sterile water. Dressing applied for about 1 week. Total dosage 14,000 units.	Pain subsided immediately after first instillation for about 12 hours. Later it commenced again. After the 2nd one, pain subsided completely and the ulcer is looking healthy. After the 4th it showed signs of epi- thelialisation.

One case of two ulcers of the type of Naga sore of the feet was dressed with Penicillin with dramatic result. The ulcer was cured in fourteen days.

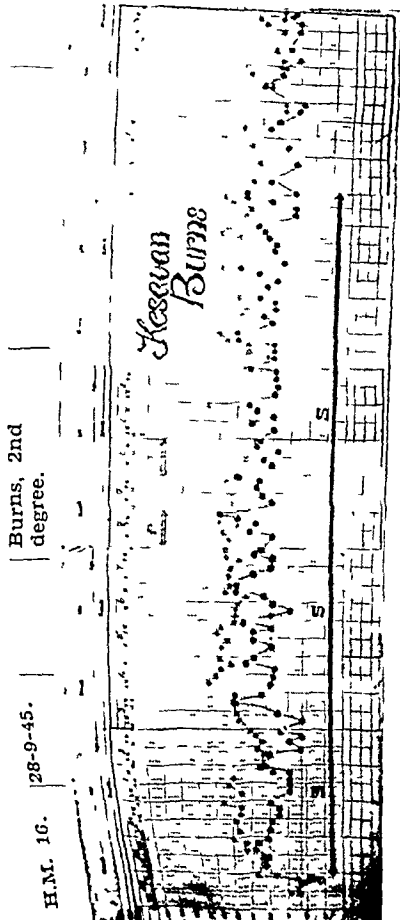
BURNS

Nationality, sex and age.	Date of admission.	Date of discharge.	Diagnosis	Investigations.	Signs & Symptoms.	Special features of the case and remarks.	Treatment.
1. H.M. 23.	28-9-15.		Burns 2nd degree.			Reported in Dec. 45. Showed signs of Neuritis ulnar nerve on the Right side. Reported in Jan. 46. He is feeling quite fit.	On admission patient was given hot coffee by mouth. A.T.S. 3,000 units. A.G.S. 4,000 units. Morphia 1 gr. given immediately, open intravenous plasma started and burns have been dressed removing all blebs and cleaning with 1% gentian violet and streptocide powder. Total plasma 1,000 c.c. followed by hypertonic saline for four days daily 2 pints from the day of admission. 7-10-100,000 units of Penicillin. I.M. drips along with saline. 11-10-100,000 units I.M. drips along with saline. Cibazol 60 tablets.

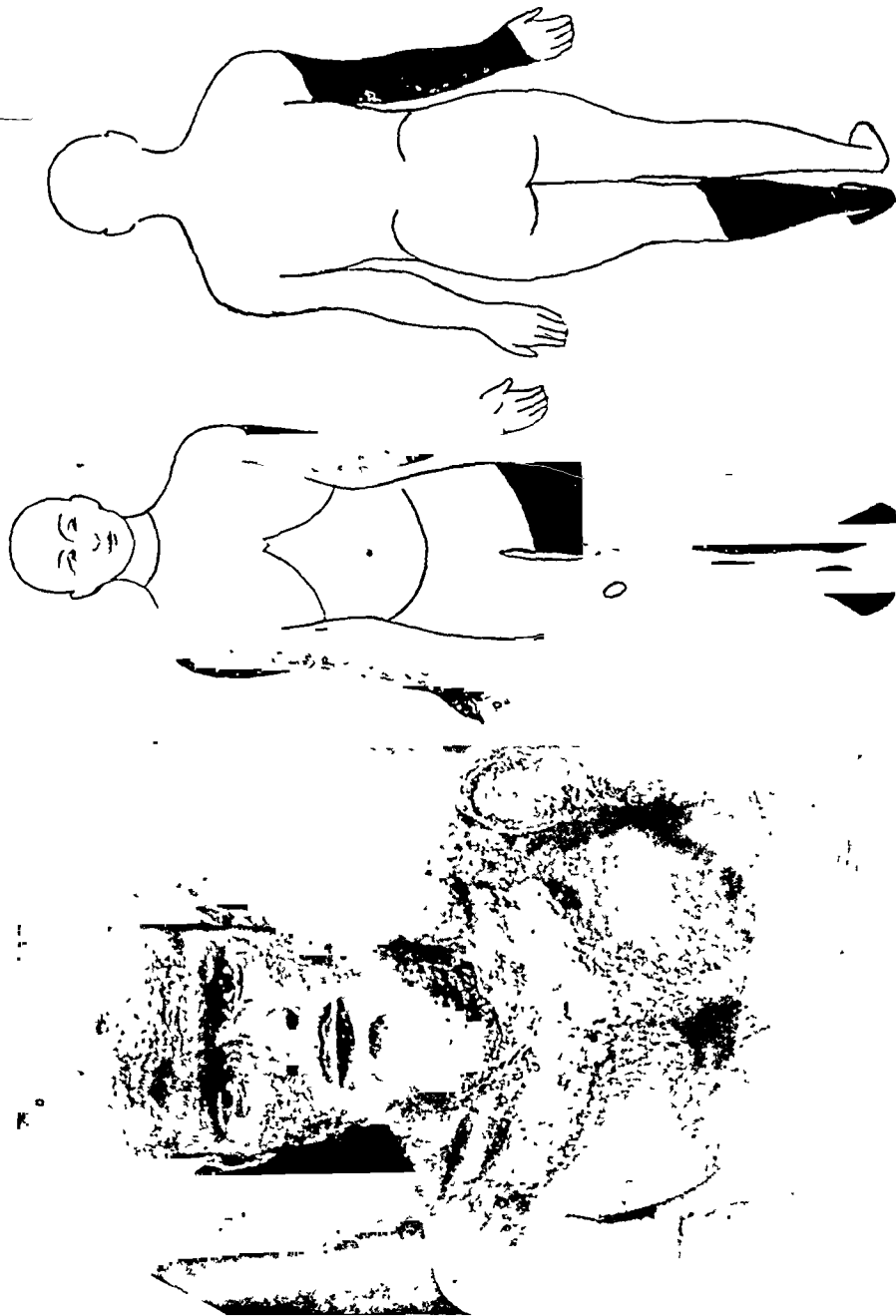
Temperature and pulse chart of Case No. 1.—Inset is a clinical picture of the case showing the extent of the burns.



Clinical photograph of the case. Line drawings showing the extent of the burns.



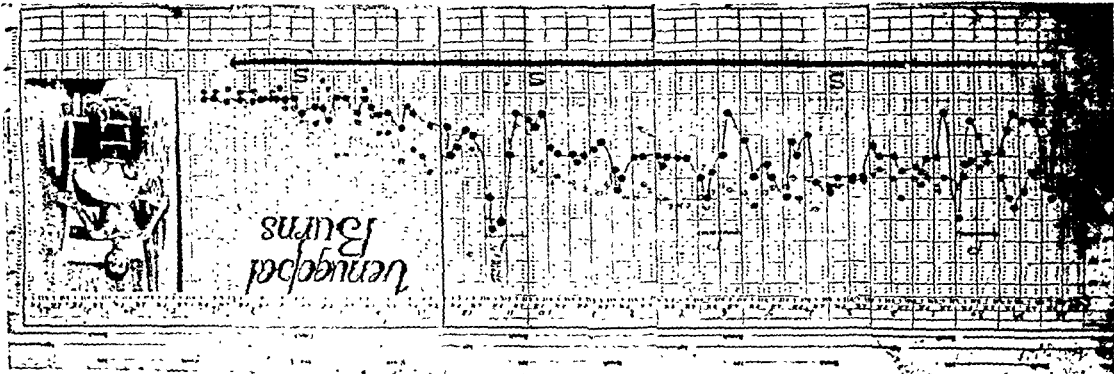
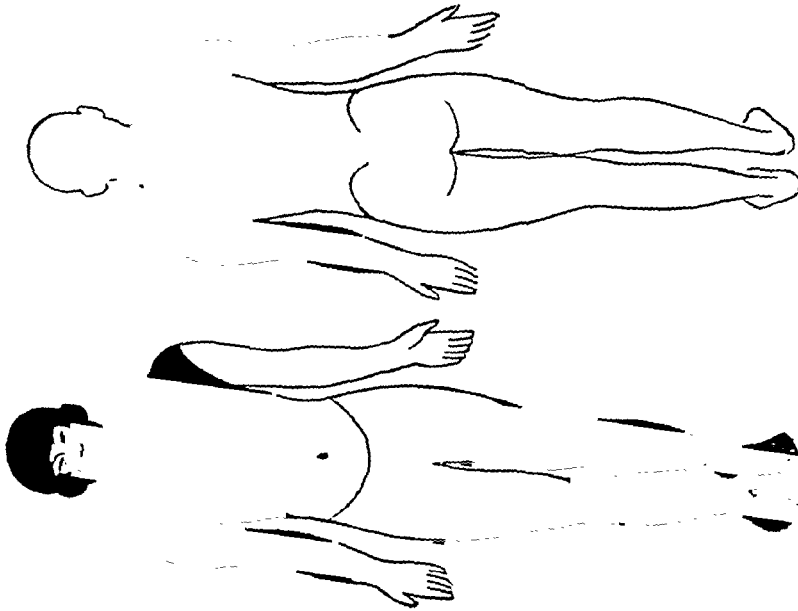
Temperature and pulse chart.



Reported in Jan. 46. He is feeling fit.

On admission, the patient was given hot coffee by mouth, A.T.S. 3 000 units A.G.S. 4,000 units, Morphine 1 gr. given immediately. Open intravenous plasma started and burns have been dressed removing all blebs and cleaning with 1 per cent gentian violet and streptocide powder. Total plasma 1,000 c.c. followed by hypertonic saline for 4 days, daily 2 pints from the day of admission. 8-10-100,000 units Penicillin at 20,000 units intramuscularly. 10-10-100,000 units of Penicillin intramuscularly Ciba-zol 72 tablets from 29-9-45 to 17-10-45.

Burns 2nd and 3rd degree.



He had to be skin-grafted.  
Discharged against advice.  
Nothing is known afterwards.  
This is a case of extensive burns of the 2nd and 3rd degree.  
To prevent secondary infection which causes toxemia and death after recovery from the initial primary shock Penicillin was given with benefit.

On admission the patient was given hot coffee by mouth and A.T.S. 3,000 units, A.G.S. 4,000 units, Morphine 1 gr. immediately.  
Open intravenous plasma started and burns have been dressed after removing blisters and cleaning with 1% Gentian Violet and Streptocide Powder. Total plasma 1,000 c.c. followed by hypotonic saline for 4 days daily 2 pints from the day of admission.  
30-9-45—100,000 units of Penicillin in I.V. drip along with saline.  
6-10-45—100,000 units along with I.M. drip saline.  
11-10—do. do.  
Total cibalzol given 82 tabs.  
29-9-45 to 17-10-45.

# CLINICAL ASPECTS OF ACUTE INTESTINAL OBSTRUCTION WITH REFERENCE TO VOLVULUS AS A CAUSE OF INTESTINAL OBSTRUCTION

By

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(A summary of the thesis for the M.S. Degree of the Patna University.)

Acute intestinal obstruction is by far the commonest "acute abdomen" admitted to the Medical College Hospital, Patna, about 50 to 60 cases being admitted yearly. A total of 398 cases admitted from 1934 to 1943 were collected which included a detailed study of 73 cases based on personal observations.

Investigations were undertaken to find out how far the symptoms and signs help in the prognosis with special reference to the type of intestinal obstruction, namely, volvulus.

**Aetiology:**—The cause of this condition is by no means certain but the poor nutritional condition of the hospital class has been found to play an important part in volvulus.

**Age Incidence:**—It has been found that there is a gradual increase in the incidence of obstruction as the age advances till the maximum is reached at the age group 40 to 50 vide Table I.

TABLE I.

Age incidence of intestinal obstruction among 398 cases from the records of the Medical College Hospital, Patna, 1934-1943.

Age.	No. of cases.	Percentage.
0 — 5	—	—
6 — 10	—	—
11 — 15	5	1.3
16 — 20	18	4.5
21 — 30	51	12.8
31 — 40	101	25.4
41 — 50	134	33.6
51 — 60	73	18.3
60 & over	16	4.0
Total	398	99.9

TABLE II.

This shows an analysis of the causes of intestinal obstruction of 398 cases admitted between 1934 and 1943 in the Patna Medical College Hospital and gives the ratio of incidence between males and females and more particularly it brings into relief that the Volvulus is 3 times as common among males as in the females.

Various causes of obstruction	Male	Female	Male/Female
Volvulus	149	53	3 : 1
Strangulated Inguinal Hernia	136	Nil.	136 : Nil.
Other external strangulated Hernia, femoral Umbilical, etc.	Nil.	10	0 : 10
Tuberculous strictures	1	8	1 : 8
Tuberculous adhesions, etc.	3	12	1 : 4
Intususception	6	1	6 : 1
Cancer	6	1	6 : 1
Bands (Non-tuberculous)	5	1	5 : 1
Ascaris	Nil.	2	0 : 2
Gumma	1	Nil.	1 : 0
Hirschsprung Disease	1	Nil.	1 : 0
Congenital Membrane	Nil.	1	0 : 1
Faecal Implication	1	Nil.	1 : 0

**TYPES OF OBSTRUCTION:** COKKINS (1936) classification simplifies the causes of obstruction by including only those factors which cause a mechanical impediment to the onward progress of intestinal contents; this has of necessity excluded the functional causes of obstruction which have a different aetiology, pathology and treatment.

Differentiation of obstruction into obstruction with strangulation and simple obstruction

tion is of the greatest importance from the point of view of prognosis. Strangulation suggests urgency and is a calamity requiring urgent radical treatment. In simple obstruction however there is not the same urgency.

TABLE III.

Gives the incidence of the causes of intestinal obstruction among 73 cases personally studied by the author.

Simple obstruction			Obstruction with strangulation		
Type of obstruction.	No.	% of total	Type of obstruction.	No.	% of total
Adhesions	6	8.21	Volvulus	26	35.61
Intussusception	2	2.73	Strangulated Hernia		
Carcinoma	2	2.73	Inguinal	25	34.23
Stricture	3	4.09	Femoral	2	2.73
Ascariasis	1	1.36	Umbilical	1	1.36
Band	1	1.36	Bands	2	2.78
Cong. Megacolon	1	1.36			
" membrane	1	1.36			
Total	17	23.2	Total	56	76.7

From the above it will be seen that 26 (35.61 per cent) out of 73 cases were cases of Volvulus.

TABLE IV.

From the table given below it will be seen that Volvulus is the commonest cause of acute intestinal obstruction, accounting for 202, i.e. 50.7 per cent out of a total 398 cases and shows an abnormal incidence when compared with Cokkins and Mayo et al 2.6 and 6.2 per cent respectively. The incidence of Volvulus based on personal observation is also high being 35.61 per cent even though the total number of cases reviewed are only 73 cases.

Simple obstructions			Obstructions with strangulations		
Type	No.	% of total.	Type	No.	% of total.
Adhesions	15	3.7	Volvulus	202	50.7
Intussusception	7	1.8	Strangulated Hernia		
Faecal			Inguinal	136	34.2
Impaction	1	0.25	Femoral	4	1.0
Carcinoma	7	1.75	Umbilical	5	1.5
Ascariasis	2	0.50	Bands	6	1.5
Gumma	1	0.25			
Cong. Megacolon	1	0.25			
Stricture	9	2.25			
Cong. membrane	1	0.25			
Total	44	11.25	Total	354	83.9

From the preceding table it will be noticed that Volvulus was the commonest single type of obstruction and that the maximum age incidence was 40 to 50.

There are several factors that may together be responsible for the above finding:—

1. The degenerative changes which commence in the system at this age cause laxity of the musculature which in turn permits the sagging of the bowels.

2. Constant loading of the pelvic colon with vegetable roughage over a number of years may be responsible for the lengthening which is frequently seen in the pelvic colon.

3. Cicatrizations taking place in the mesentery of the pelvic colon cause a narrowing of the pedicle—a condition which predisposes to Volvulus. Cicatrization is mainly the cumulative effect of repeated chronic inflammatory changes in the mesentery secondary to infections with amæbic and bacillary dysenteries.

Prasad (1942) explained that the high incidence of Volvulus among the poor was due to a combination of a diet of high residue content and, the frequent inflammatory diseases to which they became subjected.

Thus, loading, lengthening of the pelvic colon and cicatrization on the mesocolon causing a narrowing of the pedicle of the mesentery are the main factors causing Volvulus. Similar instances occur also in Russia, Finland and Poland, where coarse vegetable diet is consumed by the poor population. Weinstein (1938) stated the frequency of volvulus in Russia to be 50 per cent of all obstructions.

The diminution in the age incidence after 50 is probably fallacious because there is a relatively smaller number of people living above this age. However the figures are in general agreement with those of MILES (1923) and others.

The figures for strangulated inguinal hernia are in conformity with those given by other workers, Cokkins (1931) Mayo et al (1940) and KINI (1938).

The incidence of strangulated hernia (umbilical, femoral and ventral), that occur mostly among women is very low compared to figures given for Western Countries. The author's figures are 4.09% (vide table III) compared to 20.8 per cent and 27.4 per cent Mayo et AL and Cokkins respectively. This may be explained by:

- (a) Lower ratio of women in India.
- (b) Average age of population is less (these hernias occur at advanced ages).
- (c) Relatively sedentary life of our women.
- (d) Reluctance (due to social customs) on the part of the old women and their relatives to seek institutional treatment.

The incidence of intususception among Bihari patients is found to be very low, 2.73 per cent compared with Cokkins (1936) 15 per cent. This is to some extent probably due to the disease remaining undiagnosed among children and their not being brought to the hospital. The cases of intususception which have been seen were mostly among adults.

Occurrence of Carcinoma in the gastrointestinal tract causing obstruction is very low in Bihar. The incidence of Carcinoma generally appears to be lower.

Three cases of stricture of the small intestine causing obstruction have been seen. Two were labelled as tuberculous on clinical evidence alone. It appears that these were probably cases of granulomatous ulcers of the small intestine causing obstruction as described by COLP (1938), KINI (1941) and other authors under that heading. No acid-fast bacilli were found in the stools of these patients nor was there any evidence of either proliferative or adhesive type of tuberculous peritonitis. On the whole there did not appear to be any direct clinical evidence of tuberculosis in other parts of the body. The author therefore is of the opinion that in all probability the obstruction was caused by granulomatous lesions as described by other workers. One case of congenital Megacolon and one of congenital membrane causing obstruction were seen. The peculiar feature of interest is the advanced age at which these lesions were seen 15 and 18 years respectively.

**Obstruction.**—This is generally of gradual onset in cases of volvulus, the twist increasing with time and sometimes because of indigenous treatment given for the slight pain and constipation present. The following factors would probably increase the twist:—

(a) Slight mechanical obstruction leads to irregular and forced peristalsis with early distension by gases which is the key point of the vicious circle.

(b) The above is made worse by cathartics (often administered by lay people.)

(c) Forceful massage of the abdomen—done by the heel in village practice.

The distension gradually increases in the loop as the partial twist tends to cause venous congestion by preventing free venous return—thus gaseous absorption is stopped—at the same time fluid is poured out in to the loop—distension causes further obstruction at the twist and so a vicious circle is established.

#### Presenting symptoms, their frequency and significance.

The presenting symptoms in the majority of cases have been, pain, constipation, and vomiting. Bernard (1910) Quervain (1923) Adams (1923) and Cope (1940) mention pain, shock, constipation, distension, tenderness of the abdomen and visible peristalsis as the main symptoms. Gordon Taylor (1928) considers that pain is the first symptom.

Colic of the small intestines is referred to the epigastric and umbilical regions and that of the colon to the hypogastrium (Cope 1940). Pain accompanied by violent restlessness of agony is usually due to some form of obstruction.

Gordon Taylor (1928) has summed up the character of the pain in the clearest terms. "Pain is severe, continuous, and unremitting and the patient has no relief until such time as the nerves of the strangulated coil become poisoned or exhausted. The disappearance or abatement of pain in a clear-cut clinical picture of acute intestinal obstruction may have a sinister significance and may indicate that gangrene or perforation of the strangulated coil has eventuated or it may result

from deepening narcosis of intense toxæmia or collapse[.]”

The pain is also proportional to the extent of intestine implicated, to the tightness of the strangulation, and the portion of intestine involved.

Sooner or later, colicky paroxysms of pain supervene upon continuous pain; they are due to the violent peristaltic efforts of the intestine to force its contents past the obstruction: this type of pain is short lived, the muscular tunic of the bowel giving up the unequal contest.

A. *Pain* was undoubtedly the most predominating symptom—it was present in every case; and was the first complaint in 83.5 per cent of cases.

Romanis and Mitchener (1937) and Handfield Jones (1938) state that the pain in cases of strangulation is of sudden onset. The author's observation of 56 cases of strangulation shows that only 25 of these (44.7 per cent.) had an acute onset of pain. In the rest the pain was of mild onset becoming severe in an hour or more. Further it has been noticed that sudden onset of pain was present in only two out of fifteen cases, i.e., 13.3 per cent. of volvulus of large gut; whereas in small gut strangulation 23 out of 43, i.e., 53.5 per cent. of cases had sudden onset of pain.

The observations of Gordon Taylor have been amply substantiated. It has been shown that the severer the pain the better the condition of the patient and the better the prognosis. The prognosis was found to be directly proportional to the severity of the pain. The mortality was 14.2 per cent. (one out of seven died) among those with moderately severe pain and 78 per cent. (14 out of 18 died) among those with mild pain on admission. Finally it may be stated that as the condition advances colicky pain is replaced by a pain of constant character.

B. *Constipation* was present in every case. Absolute constipation was absent in two—every enema brought away some flatus. One was a case of congenital megacolon and the other was proved at laparotomy to be a

nalf turn volvulus of small gut. This shows that presence of flatus in the enema does not rule out the necessity of operation, but that the case must be judged as a whole.

C. *Vomiting*:—Acquires an added importance in a hot and dry climate by the rapid dehydration it produces. Only 46 cases out of 55, i.e., 86 per cent. among the small gut obstructions had vomiting. In large gut obstruction vomiting is of late onset and was found in 12 out of 18 cases. The latter were advanced cases with a mortality of 75 per cent. It will be seen that vomiting is not a *sine quo non* even of small gut obstruction. It is interesting to note that of 3 cases who had faecal vomiting the “herald of death,” only one died.

#### Other Clinical Observations.

1. *Distension*:—The literature on the causes and effects of distension is fairly extensive and may be summarised as follows:—

(a) Swallowed air (Wangensteen 1939) is responsible for 68% of distension proximal to the site of obstruction—this was substantiated on œsophagectomy by Wangensteen and Rea (1939) and confirmed by Singleton Et Al (1942).

(b) Bacterial decomposition.

(c) Gaseous diffusion into intestines from blood, McIver (1933).

(d) Failure of normal methods of elimination of intestinal gases (Wakely & Hunter 1940).

(e) Accumulation of secretory juices from stomach, liver and pancreas above the obstruction and increased secretion of intestinal juices and mucus on the part of obstructed bowel itself.

#### Effects of Distension.

(a) Pressure on bowel wall affects the blood and lymph supply causing anæmia of tissues and congestion.

(b) Over distension interferes with normal motility of the bowel by its effects on both the nerve mechanism and the musculature of the bowel wall.



(c) By experimental distension of bowel Fine, Hurtwitz and Mark (1940) have shown that there is a fall in blood plasma and hæmoconcentration and that this was proportional to the distension.

(d) Distension may play a part in the failure of liver and kidney function (Schneider & Orr, 1942).

(e) In the presence of marked distension the respiratory mechanism is impaired by the raised and immobile diaphragm.

Among the 73 cases observed distension was found to be a variable factor, depending mainly on the site of obstruction, the duration of obstruction and the presence of or absence of vomiting. It is most marked in the cases of large gut obstruction and in volvulus rather than in a simple obstruction. In these cases the distension is most marked in the strangulated loop (Sigmoid) itself which may attain a diameter of 5" to 6" or even more. Distension in the bowel above is by contrast negligible. The strangulated loop is tense with increased pressure whereas the rest of the bowel is soft. Characteristically the loop is oval in shape, one limb lying to the left of the umbilicus and going upward and to the left and the other limb somewhat behind and to the right, the apex being pushed under the left dome of the diaphragm. Distension is of rapid onset in the strangulated loop and has been quite marked even in a strangulation of a few hours duration; further, though the loop can be easily made out on inspection yet peristalsis has rarely been observed and this can be confirmed by auscultation. At laparotomy it has been usually observed that peristalsis is present above the loop, but none in the loop itself—this comes back on decompression unless the gut is non-viable just as in strangulated hernia. Distension in small gut obstruction was more central and in some cases visible peristalsis was present. Observation has amply borne out the deleterious effects of distension. The maximum mortality (56 per cent.) was among those with severe distension—among those with moderate distension mortality fell to 26.6 per cent.

The gases concerned in distension have not been analysed, but the smell of  $H_2S$  is usually

overpowering on decompression of volvulus of the Sigmoid.

2. *Peristalsis*:—Increased peristalsis and even visible peristalsis is generally considered a valuable aid to diagnosis in obstruction—Adams 1923, Cockins 1936 and others.

However the above statement requires some modification in the case of internal strangulations of the bowel. Lewis Et Al (1940) found that as obstruction became complete loud borborygmi was replaced by a peristaltic sound of a higher pitch, having a metallic tinkling and splashing character. The above has been constantly observed in cases of volvulus and the sound is comparable to that produced in succussion splash of hydropneumothorax—though not so loud. This character is usually absent in strangulated hernia where borborygmi is usually present. Volvulus differs from strangulated hernia—in that the exudate from the loop has free access to the peritoneal cavity and perhaps the blood acting as an irritant is responsible for the reduced peristalsis as compared to that in simple obstruction or strangulated hernia.

3. *Tongue*:—In the cases under observation examination of the tongue was found to be of great value from the diagnostic, therapeutic and prognostic points of view.

Contrary to popular expectations the tongue has been found to be clean in the majority of cases of strangulation of the bowel. 44 cases out of 73 (60.3 per cent.) had a clean tongue; out of 29 cases who had some coating of the tongue only 9 cases had marked coating.

Thus the clean tongue is of some use as a diagnostic measure as it contrasts with the coated tongue so often seen in inflammatory conditions of the abdomen.

It is a valuable index of dehydration of the patient ready at hand and has been used as such in administering parenteral fluids which were stopped when the tongue became moist.

Finally the mortality of 48.3 per cent. among the 29 cases with coated tongues is contrasted with that of 20 per cent. among those who had clean tongues.

4. *Decubitus*:—The patient naturally assumes the attitude of most comfort. Cases of volvulus of Sigmoid—usually prefer to sit bolt upright—pressure on the diaphragm is relieved somewhat by this posture. Those with small gut obstruction are usually seen rolling about with colic. Both the above are in contrast to those who have inflammatory mischief in the abdomen.

5. The presence of intense thirst hardly requires any comment.

6. *Duration of Symptoms* before seeking admission.

Patients with strangulated external hernia came for admission within 30 hours of onset. They could see that something was wrong with the hernia since it could not be reduced and had become painful.

Those with internal strangulation of small gut came within 54 hours of onset. Severe pain and vomiting which showed no signs of abating, apparently drove these patients to seek admission; whereas those with simple small gut obstruction came about 83 hours after onset. The last to come were those with large gut obstruction; they all tried various measures to relieve it before seeking hospitalization, average duration was 99 hours.

7. *Pulse*:—Character of the pulse was found to be very deceptive.

It showed little relation to the ultimate prognosis of the patient except in a general sort of a way. Pulse was found to be normal in rate, tension and volume in many advanced cases where the bowel had actually become gangrenous. Scudder Et Al (1938) attribute the slow rate to Potassium absorbed from the peritoneal fluid—this does not explain the condition in some of the cases of strangulated hernia. Thus though a poor pulse meant a bad prognosis, yet the converse was not true in that a good pulse was compatible with a serious local condition.

8. *Temperature*:—Slight rise of temperature was noted in 34 cases of whom only 13 or 17.8 per cent. had a rise above 99; out of these 29 were cases of strangulation. Thus 29 out of 56 cases of strangulation (table III)

(over 50 per cent.) had a rise of temperature; thus it is an indication of strangulation rather than simple obstruction. Mortality was found to increase with a rise of temperature noted on admission.

9. *Shock-like syndrome*:—Shock—prominent among clinical features mentioned by Romanis and Mitchener (1937) and others—has only been seen on admission in patients "in extremis"; (though the others might have been in that condition earlier on) and this in spite of the crude methods of transport employed by villagers.

Shock like condition has been found in a number of cases after the operation. A number of factors may be concerned in this:—

(i) Due to anaesthesia and operation. Daniel Et Al (1943) have found that significant decline in plasma occurs in operations on the intestines.

(ii) Absorption of toxic depressor substances accumulated in veins and lymphatics absorbed into circulation on release of the strangulation (Knight and Slome 1936).

(iii) Sudden lowering of tension in the intestine and consequent local pooling of blood in the segment of bowel relieved from obstruction (Cockkins 1936).

(iv) Delayed collapse seen as much as 5—6 days after the operation, has been observed in many cases. Childs et al (1941) have observed that following the release of distension of long duration with damage to bowel wall a further fall in plasma occurs. Thus the condition would set in when enough plasma has been lost in this way, though intravenous saline may counteract it in the initial stages. It is regretted that observations could not be made with intravenous plasma.

10. *Blood Pressure*:—30 cases had a diastolic blood pressure of over 90 mm. and 11 of these had a diastolic of over 100 m.m. Hg. The systolic blood pressure showed a more or less proportionate increase. Out of

these 30, 29 were cases of strangulation. Urine showed no kidney damage. Following the operation the blood pressure came down to normal limits and was so at the discharge of these patients. The rise of blood pressure in these cases where there is increasing resistance to the flow of blood may be compared to a similar phenomenon seen in acute cases of glomerulo-nephritis and has been explained generally on beneficent compensatory reaction grounds—Boyd (1940).

#### 11. *Movement and Rigidity of the abdominal wall.*

The movement of the abdominal wall is usually free except in extreme distension due to a mechanical handicap. Rigidity is usually absent, but it needs to be differentiated from tension due to distension.

12. Tenderness has been present in 13 out of 26 cases of volvulus; this is probably due to the irritation of the peritoneum by the exudate from the strangulated loop—perhaps the blood.

13. Shifting dullness has been elicited in cases of obstruction of tuberculous origin—but absent in cases of volvulus of Sigmoid even though laparotomy showed a fair quantity of fluid; this is due to the even dispersion of fluid by the distended bowel.

*Rectal Examination* in cases of volvulus of the Sigmoid shows as ballooning of the rectum.

14. *Urine*:—Routine examination of urine has not shown anything of significance. The fluid intake and output chart was invariably kept as most of the cases had intravenous or subcutaneous fluids. 30 to 40 ounces was taken as a reasonable output in 24 hours during the summer.

15. *Blood*:—(a) Most of the cases on admission showed a high R.B.C. count—and hæmoglobin per cent. These subsequently came down to normal showing a hæmoconcentration. Hæmatocrit readings were not done.

(b) Total leucocyte count showed an increase in cases of strangulation—even of a few hours' duration and this was greater than could be accounted for by hæmocon-

centration. Mayo Et Al (1940) have observed the same phenomenon. Contrary to popular teaching—W.B.C. counts do not help in differentiating inflammatory intra abdominal troubles from mechanical obstruction—counts as high as 20,000 per c. m.m. were found, counts of 15,000 per c. m.m. were an average finding in cases of volvulus. The cause for this is by no means clear especially in cases of strangulation of only a couple of hours' duration.

(c) Blood chemistry has not been studied except in some cases where blood chlorides were usually found to be low. In one case it took nine days for blood chlorides to reach 474 mgm. per cent from 339 mgm. per cent in spite of intravenous saline.

**DIAGNOSIS**:—It is not proposed to discuss the usual diagnostic features of acute intestinal obstruction in this summary, but only a few of the features that might perhaps cause some confusion.

The presence of paralytic obstruction having been eliminated—the two enema test will usually prove the presence of mechanical obstruction. As previously mentioned in one case flatus was passed at each enema yet the patient was found to have volvulus of the small gut; thus one cannot adopt a complaisant attitude merely because flatus is being passed.

Absence of a coated tongue has been taken as an indication of the presence of mechanical obstruction but as stated above a fair percentage do have a coated tongue.

Presence of leucocytosis as mentioned above is of no help in differentiating the condition from paralytic obstruction—but it does help one in indicating the presence of a strangulation rather than a simple obstruction. This only applies in the early stages before gangrene of the bowel has set in. Tenderness of the abdomen, presence of temperature and the characters of the peristalsis are further points in differentiating strangulation specially of the small gut from simple obstruction.

There is no difficulty in differentiating volvulus of large gut from any other as the

distension in the loop is fairly rapid and the shape typical.

Two cases caused some difficulty in the diagnosis. One was a member of the house staff who developed colic—renal in distribution with absolute constipation. Auscultation revealed an almost silent abdomen. X-Ray showed a stone in the pelvis of the kidney. Enemas brought away a little flatus and faeces. This was a case of reflex paresis of the gut.

Another patient presented himself with what appeared to be a history of appendicitis and a tender lump to the rt. of and below the umbilicus. He was put on Oschener-Sherren's treatment. This patient was reviewed again after two hours and a peristalsis of the character described above of tinkling and splashing type found. His tongue was also clean. A tentative diagnosis of volvulus was made and at laparotomy volvulus of the Ileum was found. The bowel was gangrenous and was being walled off by adhesions. The patient died. This case illustrates the value of the tongue and the character of peristalsis in obstruction.

Aspiration of peritoneal fluid should prove a valuable guide to strangulation. This has been suggested by some workers but the author has no personal experience of it.

## TREATMENT.—

### Manipulative.

Scant attention has been paid to the proper use of the flatus tube as an emergency treatment in cases of volvulus of the Sigmoid and it has been considered as definitely dangerous—which it is not in skilled hands even in advanced cases. Merely introducing the flatus tube up the rectum is of little use. It usually gets coiled up in the rectum. The index finger of the left hand must be introduced to its full extent and then the flatus tube guided up to prevent kinking. The best results are obtained with the patient in the knee-elbow position. If it is unsuccessful in this posture then attempt should be made with the patient in the left lateral and the right lateral. Success may be expected unless the twist is so tight that it

will not allow the tube to pass up the lumen. Needless to say undue force must not be used. Volvulus of upto 4 days duration has been relieved by the flatus tube.

In view of the fact that the volvulus of the Sigmoid is so likely to recur—the patient should be advised excision of part of the pelvic colon at a later date when healthy condition of his bowel has been restored.

### Operative Treatment:

(a) *Pre-Operative*.—All measures possible must be taken "to make the patient safe for the operation."

The author has no experience of the Miller Abbot tube which was unobtainable during the war; but Wangenstein (1939), Blacklock (1939) and other recent workers have shown the efficacy of the tube both as a pre-operative measure and as a treatment itself in certain cases of simple obstruction. The advantages of suction drainage of the gut above to relieve some of the distension is obvious enough.

Ryles tube has been used in every patient who had any vomiting. This made the patient comfortable by checking the vomiting and relieving some of the distension. It was kept in situ during the operation and periodic suction was continued post-operatively.

Those patients who showed any dehydration were put on intravenous fluids. A generous dose of morphia was given to all patients, in addition to other methods used in resuscitation where necessary. However undue time cannot be lost in strangulation due to the danger of irreparable damage to the bowel.

### Anæsthesia:

Local, general, and spinal anæsthesia have all been tried. With the former two it has usually been a tussle to close the abdomen after the operation and one heaves a sigh of relief when the feat is accomplished. Stovain (Barkers Solution) was used where the blood pressure was about 115 mm. of mercury; in cases who had slightly lower pressure of say 110—it was also used, but the legs were firmly

bandaged from below upwards up to the thighs. Compared to the other two forms of anaesthesia, it is a pleasure to work with spinal—the operative manipulations are easier as the intestines are contracted, trauma is less and closure of the abdomen is simplicity itself. The short duration (45 minutes) of anaesthesia was quite sufficient in the average case.

Operative procedure was in general guided by the maxim "Quick in and quicker out." The least that was necessary to relieve the obstruction was done. In cases of pelvic colon no difficulty was found in closure of the abdomen as the colon was decompressed at the time of the operation by a flatus tube passed from below by an assistant. In small gut obstruction decompression had to be carried out when spinal anaesthesia was not used; this was done by a needle.

Ideally decompression should be gradual.

Primary resection of the bowel with end to end anastomosis has been recommended by Kini (1938) but it has not been practised. Where the bowel was not viable it was simply exteriorised.

#### Post-operative Treatment:

- (1) Suction by Ryles tube was continued in the immediate post-operative period.
- (2) Morphia was pushed to produce continuous narcosis; it was given six hourly. This gave the patient much needed rest and it reduced distension by increasing the tone of the bowel. Orr (1937) and Forster (1940).
- (3) Deep breathing exercises were given as a routine to ensure proper aeration of the lungs as a preventive measure against basal congestion and pneumonia.
- (4) Fluids were continued parentally as long as dehydration was present. Generally 10 minims of Adrenaline Hydrochloride was added to each pint of saline. After 24 hours intravenous fluid was replaced by sub-fascial saline given into the outer part of the thigh.

Cardiac stimulants were not found to serve any useful purposes, rather they hastened the end once collapse had started.

Volvulus of the Sigmoid is a condition very likely to recur and several of the patients among the present series had been operated once or even twice previously for the same condition. They were all advised to undergo a radical operation prior to discharge from hospital but none agreed to it. A radical operation at the time of relief of obstruction seems too hazardous a procedure, other measures such as plication of the mesentery have been failures. The author would like to put forward a tentative proposal which might be successful though it has not been tried, since the idea occurred after leaving Patna. A modified partial exteriorization of the gut might be carried out. The apex of the loop—about 3-4 inches of it might be brought out and the peritoneum sutured round it as in Pauls procedure but the two limbs be kept as far apart as possible, and then the transverse and internal oblique muscles sutured. The bowel being allowed to lie between the deep muscles and the external oblique. Since the apex would be permanently fixed by this procedure there would be no chance of a volvulus recurring. The only complication that might be expected are those found in colostomy and they are rare enough to warrant this procedure.

**Results:**—Out of a total of 73 cases of obstruction there were 24 deaths, giving a mortality of 32.87 per cent. Among the cases personally treated by the author 19 out of 56 died—a mortality of 33.9 per cent. c.f. Burgess (1932) 40 per cent. Wakeley and Hunter (1940) 40-50 per cent.

Volvulus of the Sigmoid gave the highest mortality—46.6 per cent. The operative mortality was 75 per cent. c.f. Scudder Et Al (1938) 45 per cent, Vick 52 per cent. These were very advanced cases. In 3 cases the whole loop was gangrenous; the tongue was badly coated, respiration was rapid and temperature above a 100 degree F.

The figures for volvulus of the small gut are relatively good 27.2 per cent mortality; one of these was moribund. So if this be ex-

cluded the mortality was only 20 per cent; i.e. 2 deaths out of 10 c.f. Scudder Et Al (1938) 42 per cent. This lower mortality is due to the better condition of these patients.

From a consideration of the above it is evident that the prognosis would be relatively good if only the patients could be got to hospital at an early stage of the disease. This requires constant vigilance on the part of the general practitioners and propaganda

among the public not to treat "pain in abdomen" and "constipation" so lightly. Purgatives are so easy at hand and cause so much mischief, besides giving false hopes to the patient.

I would like to take this opportunity of expressing my gratitude to Dr. U. P. Sinha, F.R.C.S.E. and Dr. B. N. Prasad, F.R.S.E. under whose guidance the original thesis was prepared and to the Patna University for permitting me to publish portion of that thesis.

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# TREATMENT OF PANCREATIC CYSTS BY PRIMARY ANASTOMOSIS TO THE STOMACH OR JEJUNUM

By

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Ever since Gussenbauer, a pupil of Billroth treated a case of pancreatic cyst by marsupialization in 1882, that method became the accepted treatment for the condition. Excision may be the ideal treatment, but this is often impracticable owing to extensive adhesions to the adjacent vital parts and to the presence of large blood vessels all around. Indeed, a few skilful surgeons have abandoned half-way an attempted excision because of the difficulties encountered (Bickham, 1924). Pedunculated cysts and cysts in relation to the tail may lend themselves to extirpation but these are very rare. Marsupialization has therefore been the operation of choice in a large majority.

A better method of treatment may be anastomosis of the cyst to the stomach, duodenum or jejunum and this has certain advantages over marsupialization. Jurasz's two cases (Jurasz, 1931) are the earliest recorded, of primary anastomosis to the stomach. Both his cases did well, as also a case of Harries' (Harries, 1934). The method was adopted by the writer in one of his cases about 4½ years ago, and the patient is known to be doing well. (Mahadevan 1943). Chapman (1941) anastomosed a cyst to the jejunum with success.

The present report relates to a further series of five cases. (Table I). Three of these were treated by anastomosis to the jejunum. One of these was associated with pancreatic calculi and the cyst in this case was possibly a true (retention) cyst. The fourth was a multilocular true cyst and the fifth a unilocular true cyst. Both were associated with calculi. These two cases were treated by methods other than the one advocated here, but are included as they bring up several points having a bearing on the subject for discussion.

## CASE REPORTS

### Case I.

PSEUDO-CYST OF PANCREAS—PRIMARY ANASTOMOSIS TO JEJUNUM 2 YEARS 8 MONTHS AGO—PATIENT DOING WELL.

A. S., male of 30, a ryot was admitted on 19-6-44 for pain around the umbilicus, 40 days' duration. The trouble started with severe generalized abdominal pain a day after a prolonged and strenuous exertion at lifting a heavy weight. He vomited thrice bringing up undigested food. Medicines administered for 10 days gave no relief. About this time, a swelling appeared just below the Xyphisternum. The pain became gradually localized to the epigastric region mainly, was worse an hour after food, and at nights was severe enough to disturb sleep. Vomiting gave only occasional relief. Appetite remained good, but he gradually lost weight probably due to the pain, vomiting and disturbed sleep. At the time of admission, he was fairly well nourished though somewhat anæmic, and weighed 114 lbs.

There was a large somewhat tender cystic swelling mainly above and to the right of the umbilicus, occupying the epigastric, right hypochondriac, umbilical and right lumbar regions and just extending to the right iliac fossa. The situation, size and shape are fairly accurately suggested in the barium-meal skiagram reproduced here (fig. 2). The portion to the right of the umbilicus was particularly prominent. The swelling moved freely up and down with respiration, could be moved from side to side, was dull on percussion and the dullness was continuous with that of the liver. The mobility of the swelling is a significant point discussed later.



**Relevant Features of Investigations:—**

Urine—Diastase content 500 units.

Motion—Fat analysis—normal.

Van-Den Bergh test—(a) Direct—delayed  
(b) Faint indirect reaction.

Fractional test-meal—Delayed acid secretion and hypochlorhydria.

Barium-meal screening—Vigorous peristalsis of stomach, the contents emptying fairly easily into the duodenum. The "C" curve of the duodenum was markedly pushed out and stretched.

Barium-meal skiagram—Large extramural filling defect of the outline of the stomach in several pictures, two of which (figs. 1 & 2) are reproduced here.



Fig. 1. Case 1.

Pre-operative Barium meal skiagram—20 mts. picture showing extra mural filling defect of the stomach.

**Operation :**

On 1-7-44 under spinal anaesthesia. A large cystic swelling was noticed tensely stretching the lesser omentum and stomach in front and

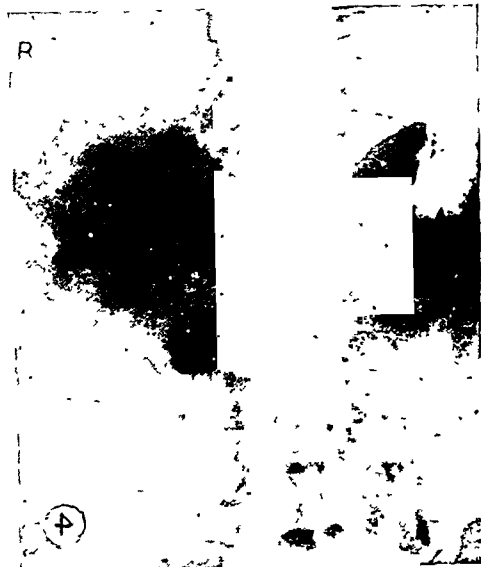
the transverse meso-colon below. It was abutting above, against the under surface of the liver. The gall bladder looked somewhat distended, but emptied easily on pressure, was of normal colour and contained no stones. The cyst wall was very thin and during the course of manipulation,



Fig. 2. Same case.

Pre-operative Barium meal skiagram 3½ Hrs. picture; the oval outline at the top left of picture fairly accurately corresponded to the situation, size and shape of the cyst.

fluid began leaking from a spot. The surroundings were well packed off and a trocar and cannula introduced into the cyst at a convenient site above the level of the stomach. During this process the cyst wall tore and a good quantity of fluid escaped into the peritoneal cavity. All the fluid was quickly aspirated off by suction and the peritoneal cavity carefully mopped. The pancreas was felt to be hard and nodular, possibly due to chronic pancreatitis. The cyst was packed with gauze, when the most dependent part of the cavity was found to be below the transverse colon stretching the transverse meso-colon. Here, an area comparatively free from large blood vessels was chosen for anastomosis to the jejunum using a loop 12" below the duodenojejunal flexure. The stoma was 1½" wide. The method of anas-



Figs. 3 & 4. Same case.

Post operative Barium meal pictures three weeks after operation—15 mts. and 3 Hrs. pictures respectively. Note the almost complete disappearance of the extramural filling defect of the stomach except for a suggestion of it.

tomosis was exactly as for a gastro-Jejunos-tomy. The original tear on the cyst wall was sutured and this area and the area of anastomosis covered over by omentum. Morrison's pouch and the corresponding area on the left side were drained through stab incisions in the loins. The capacity of the cyst could not be accurately assessed as it ruptured. It was well over two pints. The fluid was clear, thin and straw-coloured with small opaque white specks floating in it.

The post-operative course was uneventful. The drainage tube was removed after 48 hours.

Bio-chemical examination of the fluid showed marked lipase and amylase activity, but tryptic activity was slight, in fact too slight to be indicative of pancreatic origin. These aspects are discussed later. Histological examination of a portion of the cyst wall showed hyaline fibrous tissue without any evidence of pancreatic tissue in it.

Three weeks after operation the urinary diastase had come down to 10 units. Post-operative barium-meal skiagram taken about the same time showed no filling defect (figs. 3 & 4) except for a suggestion of it.



Fig. 5. Same case.

Post-operative Barium Meal picture 4 months after operation. Note the total disappearance of the filling defect.

Pictures taken four months later, showed complete disappearance of the filling defect. (fig. 5).

The patient was discharged on 25-7-44. He periodically reported for observation and is now known to be at his work keeping good health. He put on 16 lbs. in weight within four months of operation.

## CASE II.

TRUE CYST (RETENTION) OF PANCREAS WITH CALCULI—REMOVAL OF CALCULI AND ANASTOMOSIS OF CYST TO JEJUNUM TWO YEARS AGO—PATIENT DOING WELL.

Y. N., Hindu, male of 35 years, a ryot, was admitted on 22-1-45 for severe epigastric pain of two years' duration. The pain used to radiate to the umbilical right hypochondriac and both iliac regions. It was worse after food and induced vomiting used to give occasional relief. While awaiting investigations in hospital he had to be given morphia frequently. He was emaciated and somewhat anæmic. The right epigastric and hypochondriac regions were tender. No mass was palpable.

The following are relevant findings of investigations:—

Urine—Diastase 20 units.

Hæmoglobin—70%

Blood sugar—177.9 mgms. %

Plain skiagram showed mutiple pancreatic calculi.

Barium-meal skiagram—showed no abnormality.

Fractional test-meal—Both free and total acidity were somewhat below the normal.

Operation on 15-2-45. Under spinal anæsthesia.

A tense cyst, hitherto unsuspected, about  $2\frac{1}{2}$ " in diameter was situated in the head of the pancreas pushing forward the duodenum. The stomach, duodenum, liver, gall-bladder and other viscera were normal. The greater omentum in front of the cyst was dissected at a convenient area free from blood vessels and the cyst tapped. 70 c.c. of thin, dirty, brown fluid was drawn. Through a small incision into the cyst several small calculi lying free in the cyst were removed.

No communication could be detected between the cyst and the main pancreatic duct or the duodenum. A few small calculi were felt in the tail of the pancreas but these were incorporated in the gland substance and so were not interfered with. The duodenum was mobilized with a view to try and anastomose the cyst to it, but this did not appear easy. The cyst was anastomosed to the jejunum 12" below the duodeno-jejunal flexure bringing the selected coil in front of the transverse colon. A stoma one inch wide was made and omentum was wrapped round the anastomosis.

The fluid aspirated showed faint lipase activity, but no tryptic activity, thus resembling more a pseudo-cyst collection.

The post-operative course was uneventful. He had no more pain, was in good health and had put on 20 lbs. in weight within a year of operation.

## Comment:

Some special features in this case require comment. It was difficult to decide whether the cyst was a retention cyst directly related to the pancreas or was only a pseudo-cyst. Had a communication with the pancreatic duct been found, anastomosis of the cyst to the jejunum would probably have been unnecessary. As things stood, it was feared that to have merely tapped the cyst and removed a few free calculi would not preclude a recurrence. Anastomosis was therefore considered a wise step. *Incidentally it may be pointed out here that a small cyst of the size met with in this case would not lend itself to marsupialization.*

## CASE III.

LARGE PSEUDO-CYST IN A PREGNANT WOMAN—ANASTOMOSIS OF CYST TO JEJUNUM—DEATH DUE TO SHOCK? DUE TO ACUTE PANCREATITIS?

A lady of about 20, six months pregnant, had a very large cystic tumour of the abdomen. Ever since her previous delivery a few years earlier, her abdomen never reached a normal size. She felt that it was gradually bloating up till ultimately it became so large as to interfere with breathing.

A colleague opened the abdomen thinking the cyst to be ovarian in origin and found it to be a pseudo-pancreatic cyst. Knowing my interest in the subject he was kind enough to send for me and permit me to operate on the case. The cyst was tapped and 15 pints of fluid drawn. It was then anastomosed to the jejunum by a method similar to the one adopted in Case II.

The patient's general condition was good at the end of the operation. However she later developed symptoms of severe shock in some ways resembling that of acute pancreatitis. The pulse became fast and thready and there was mild cyanosis. She became cold; blood transfusion and other methods of resuscitation proved futile and she died 48 hours after operation. No post mortem was available.

#### Comment:

That there were symptoms suggestive of acute pancreatitis is a disturbing factor to be taken note of and commented on. It calls for hesitancy in recommending this method of treatment as being generally applicable. Could pregnancy have in any way contributed to the fatal issue? Probably not.

#### CASE IV.

**MULTILOCULAR TRUE CYST OF THE PANCREAS WITH SMALL CALCULI IN THE SUBSTANCE OF THE PANCREAS—TAPPING THE CYSTS AND CHOLECYSTO-JEJUNOSTOMY 1 YEAR AND 8 MONTHS AGO—PATIENT DOING WELL.**

V.S., a Hindu male of 30, a petty merchant came for abdominal pain of 1½ years duration, the pain having become particularly severe during the later six months. It was stabbing in nature, more or less constant though worse about ½ an hour after food, was felt mainly in the epigastrium and radiating to the back and right lumbar regions.

At the time of admission the patient was very ill, anæmic, emaciated, had an icteric tinge of the conjunctiva and was in agonizing pain. There was some tenderness and rigidity in the epigastrium. A mass was felt in the right hypochondriac and epigastric regions, extending four fingers below the costal margin. It was continuous with the liver dullness and moved up and down with respiration.

The following are relevant findings of investigations:—

Urine—Trace of sugar; Diastase—100 units.  
Plain X-ray Abdomen—Pancreatic calculi in head and tail areas.

Van-Den Bergh test—Direct positive delayed. Indirect positive.

Liver efficiency—Below normal (Levulose tolerance and Quick's Hippuric acid tests).

Fractional test meal—Normal findings.

Barium meal skiagram—Filling defect of the pyloric regions with a markedly pushed out "C" curve of the duodenum (Fig. 6.)



Fig. 6. Case 4.

Pre-operative Barium Meal skiagram 5 mts. picture. Note the filling defect in pyloric region of the stomach and markedly pushed out "C" curve of the duodenum caused by the cyst. Note also the small shadow of pancreatic calculi within the "C" curve.

Operation on 9-7-1945 under Spinal anaesthesia:

A large multilocular cystic swelling of the head of the pancreas was found pushing the duodenum well forwards. The stomach and duodenum were dilated. The liver, gall-bladder and spleen were normal. The cyst being multilocular was tapped in four different places and altogether about 15 ounces of thick

glairy fluid was drawn. Through none of the cysts could the pancreatic duct be reached nor any stone felt. The stones were small and incorporated in the pancreatic substance and except for a small stone none else could be removed. The openings made in the wall of the cysts were all carefully sutured and covered over with peritoneum. The multilocular nature of the cyst precluded any possibility of anastomosis to Jejunum. But in view of the jaundice and the possibility of an increasing accumulation in the cyst causing later a bile duct obstruction cholecysto-jejuno-stomy was performed 16" below duodeno-jejunal flexure.

Morrison's pouch was drained through the right loin and the lesser sac through the left.

The aspirated fluid had no tryptic activity but there was amylase and very marked lipase activity.

The post-operative course was uneventful except for a mild sepsis in the wound. The pain disappeared and the patient became comfortable. He put on 11 lbs. in about 5 months, though his appetite had not become quite normal even by that time.

#### CASE V.

TRUE CYST (RETENTION) OF PANCREAS WITH CALCULI IMPACTED IN AMPULLA OF VATER (a) REMOVAL OF CALCULI AND EXTERNAL DRAINAGE OF CYST—RELIEF FOR 5½ MONTHS—(b) DEVELOPED A PERSISTENT FISTULA—FAILURE OF OPERATION TO CLOSE THIS—DEATH THREE WEEKS AFTER.

G. S., a Hindu male of 20 was admitted on 6-2-46 for severe epigastric pain of 5 years' duration. It was practically continuous for the last two years. There was some relief for an hour after food, but soon it became so severe as to cause even breathlessness, (to quote the words of the patient), and would radiate to the back, loin and sometimes to the shoulders. Occasionally spontaneous vomiting occurred with some relief. There was visible peristalsis of the stomach and the patient himself had noticed a mass moving in the upper abdomen occasionally. He could

not lie flat on the back with legs stretched. There was marked tenderness about 1½" above and to the right of the umbilicus.

The case was clinically diagnosed to be duodenal ulcer with stenosis. The constancy of the pain was attributed to a possible erosion of the ulcer into the pancreas. As the patient was in great misery with pain and as the diagnosis seemed to be obvious no time was spent in elaborate investigations. He was operated on 12-2-46. A cyst of the head of the pancreas, the size of a badminton ball was noticed pushing forward the 1st and 2nd parts of the duodenum. The pancreas was hard and nodular. On tapping the cyst 50 c.c. of kanji like fluid, rather opaque-white with a slight tinge of red (probably due to hæmorrhage) was drawn. Digital examination through a small incision into the cyst revealed a hard star-shaped calculus deep down in relation to the termination of the pancreatic duct. Further examination showed it to be impacted in the ampulla of vater. It was removed through a small incision in the anterior wall of the duodenum: it could not be removed entire and had to be broken, when two fairly large bits and several sand like stones were removed. The cyst itself was drained through a stab incision in the loin. A few more small calculi were felt but as they seemed incorporated in the substance of the gland and not in the duct they were not interfered with.

Biochemical examination of the fluid showed some tryptic activity and marked lipase and amylase activity. The dry weight of the stones was 0.2 gms. They were composed of calcium carbonate with a trace of phosphate.

The patient became free from pain and his appetite and general condition rapidly improved. Discharge from the tube draining the cyst stopped soon. But whenever the cyst was washed through, some bile-stained fluid, occasionally undigested food particles and even frank pus escaped. Consequently the tube was retained as long as these things were washed out. In the meantime the patient was beginning to complain of pain in the left epigastric region. Skiagram showed multiple pancreatic calculi in the head and tail of the pancreas. The pain was increasing in severity and sometimes even colicky and was beginning to undermine the health of the patient. It was thought that either the

original finding that the calculi were in the substance of the gland was wrong or fresh calculi had formed in the duct.

Hoping to remove these and at the same time anastomose the cyst of the duodenum a second laparotomy was performed 5½ months after the first operation. The duct was opened into and examined. No calculi were found in the duct. They were all in the substance of the gland. A catheter was introduced into the duct and brought out through a stab incision in the left loin. The peritoneum in front of the pancreas was carefully sutured around the catheter. The general condition of the patient was not good. Access to the cyst for anastomosis was not easy and the procedure had to be postponed. 500 c.c. of plasma was given on the table, followed by intravenous drip glucose saline.

The post-operative course was stormy. From the very next morning after the operation bile-stained fluid began pouring through the tube draining the cyst. The patient began losing ground, the usual methods of resuscitation (transfusions, Vitamin K etc., etc.) proving of no avail. An operation to dissect up and tie off the fistulous track was only partially successful. After 48 hours the fistulous track reopened and again began discharging. *One particular symptom worthy of mention was, during this turbulent course the patient used to get frequent spasms of typical tetany, which were relieved by injections of calcium gluconate.* Possibly diffusible calcium was being lost in the pancreatic juice escaping through the fistula. A reference to this aspect has been made by other observers (Aldis, 1946).

The patient died three weeks after the operation. Post Mortem examination showed the fistulous track leading up to a cavity about 1½" in diameter, filled with pus and located between the liver and first and second parts of the duodenum, and walled off by adhesions around. An opening, easily admitting the tip of the little finger, was communicating with the duodenum through the medial wall of the cavity. The pancreas, mainly the body, was in a state of gangrenous sloughing. All the stones were found in the substance and none in the duct.

### Comment:

In retrospect, it is felt that the best interest of the patient could possibly have been served, by stopping at the first operation with mere removal of the calculi impacted in the ampulla or in addition anastomosing the cyst to the duodenum, instead of draining the cyst externally. The pain which recurred later, was possibly irremediable as it was very likely due to calculi in the pancreatic substance.

### DISCUSSION

A perusal of the literature shows, that the majority of the pancreatic cysts treated by anastomosing the cyst at a single sitting to the stomach or jejunum have done well. With the exception of cysts, hydatid in origin, this treatment appears applicable to all cases of pseudo-cysts, in which marsupialization has hitherto been the operation of choice. Possibly in selected cases of true cysts also, the method has a place, though the scope for this seems to be more limited.

The drawbacks of treatment of pseudo-cysts by the classical method of marsupialization seems to be several.

(i) A long period of drainage is necessary in many cases, requiring all the time, meticulous care to prevent troublesome excoriation of the skin. In fact, Kerr (1918) reported a case in which the sinus track existed for fifteen years (quoted by Judd et al., 1931). These later authors had cases in which the wound continued to discharge for a year, sometimes as long as two years (Judd et al., 1931). Cases have been reported where cure had to be effected by dissecting up the sinus track and implanting into the stomach, (Gutierrez, 1926 Jañes 1934), duodenum, (Ombredonne, cited by Bickham), jejunum (Chapman 1941) or even into the gall-bladder (Karl Meyer, quoted by Koucky, et al., 1941) Such secondary operations are likely to be difficult and dangerous, because of extensive adhesions resulting from the original operation and the existence of a long standing sinus.

(ii) Sometimes infection of the cyst occurs through the drainage track exposing the

patient to the dangers of chronic sepsis and secondary hæmorrhage.

(iii) Recurrence of the cyst has been known to occur weeks or months after a successful marsupialization and the author has personal knowledge of such a case.

Possibly, anastomosis to the duodenum is a more sound procedure as being the nearest approximate to the normal anatomical conditions, but the cramped position of the 1st part and the absence of mesentery to the 2nd and 3rd parts are likely to render the operation more difficult and hazardous. However, the choice may largely depend on, which of the viscera, the stomach duodenum or jejunum is adjacent to the area of the cyst selected for anastomosis: and the choice of this area again largely depends on a combination of an easily accessible part of the cyst being relatively free from large blood vessels. In Jurasz's cases (quoted by Rowlands and Turner, 1936) and in one of the writers (Mahadevan, 1943) the cyst was anastomosed to the posterior aspect of the stomach. A fear has been expressed (Harries, 1934) that in posterior anastomosis, the stomach contents may enter the cyst and give rise to complications. All that can be said is that in the above cases no such trouble arose. The second objection is that "posterior anastomosis" resembles a perforation of the gastric ulcer into the lesser sac too closely to be undertaken without serious consideration. Perhaps, in view of this, where anterior anastomosis is technically possible it is better adopted. In the case reported by Harries, anterior anastomosis was adopted with success.

In case No. 1 reported here, though the cyst ruptured and the peritoneal cavity was contaminated no untoward event happened. This was possibly because of the very poor tryptic activity possessed by the fluid. Indeed, it is lucky that the majority of pseudo-cysts and many true cysts contain very little pancreatic juice. The greater part of the bulk in the former is due to the out pouring of a large amount of fluid from the surrounding tissues in response to the intense irritation caused by the escape of a small quantity of pancreatic juice. Even some true pancreatic cysts do not contain pancreatic ferments, possibly

because of a co-existing chronic disease of the gland which interferes with its secretory function (Choyce and Beattie, 1923).

In cases 1 and 4 the cysts were fairly freely mobile. It is usually said in text books that pancreatic cysts are not moveable, but more than one observer has noted that they may be movable. In fact, if one examines the pancreas as a routine during every laparotomy one will find that the pancreatic head has fairly considerable mobility in every case. This is not merely due to laxity of the tissues during spinal anaesthesia. It is observed even in cases operated on under local or general anaesthesia. Probably the retro-pancreatic areolar tissue is lax, permitting the mobility. It will become all the more so if a tumour or cyst drags on the pancreas, thus rendering it more mobile. It may be remarked in passing, that intermittent disappearance and refilling of pancreatic cysts have been known to occur (Payr 1898, Judd 1931, Mahadevan, 1943). This phenomenon was not noticed in the cases reported here.

#### SUMMARY AND CONCLUSIONS.

(1) (a) Treatment of pseudo-cysts of the pancreas by primary anastomosis to the stomach or jejunum seems to be a better method than the time honoured method of marsupialization.

(b) Of 4 cases treated by the above method, 3 are doing well for periods of 2 years and 8 months, 2 years and 4 years and 8 months respectively. One case however died within 48 hours of operation with symptoms not unlike that of acute pancreatitis and so the method is not without some danger.

A much larger series of cases from various sources may have to be collected and observed before the method can be passed as being of almost universal application.

2. The method seems to have a place, though a more limited one, in true cysts also.

3. Some of the cases were associated with calculi. This and other associated conditions

Table I—SUMMARY OF CASE REPORTS

i. No.	Case	Age.	Sex.	Main symptoms.	Pre-operative diagnosis (or findings at operation).	Details of operations.	Result.	Remarks.
1.	A. S.	30	M.	Severe abdominal pain for 40 days. Epigastric swelling 30 days.	Pseudo-cyst of pancreas.	Anastomosis of cyst to jejunum.	Cured.	2 years 8 months since operation. Free from symptoms. Back at work. Put on 16 lbs. weight within 4 months of operation.
2.	Y. N.	35	M.	Severe epigastric pain for two years.	True cyst (Retention cyst) with pancreatic calculi.	Anastomosis of cyst to jejunum. (Calculi free in cyst were removed).	Cured.	2 years since operation. Free from symptoms. Put on 20 lbs. weight in the course of a year. For further details see comment at end of case report.
3.	—	20	F.	Increasing abdominal swelling of several years' duration.	Large pseudo-cyst of pancreas (contained 15 pints of fluid).	Anastomosis of cyst to jejunum.	Died 48 hours after operation.	Patient was 6 months pregnant. Death due to shock and acute pancreatitis. See comment at end of case report.
4.	V. S.	30	M.	Severe epigastric pain of 1½ years. Had mild jaundice also.	Multilocular true cyst with calculi in pancreatic substance.	Tapping of cysts, and Cholecysto-jejunostomy.	Cured.	1 year 8 months since, operation. Free from symptoms. Put on 11 lbs. weight within 5 months of operation. Says appetite not quite normal yet. Reasons for this operation detailed in case report.
5.	G. S.	20	M.	Severe epigastric pain for 5 years.	True cyst (unilocular) (? retention) and calculi impacted in ampulla of water, multiple calculi in pancreatic substance also.	(a) Calculi in ampulla removed. (Transquodrenal route) and external drainage of cyst. (b) Developed persistent fistula. Attempted closure of fistula failed.	Relieved.  Died three weeks after 2nd operation.	(a) Free from symptoms for 5½ months. (b) During this period used to get spasms like tetany, relieved by Calcium Gluconate injections. For further details see comment at end of case report.
6.	K. R.*	30	M.	Epigastric pain and swelling—20 days.	Pseudo-cyst of pancreas.	Anastomosis of cyst to posterior aspect of stomach.	Cured.	4 years 8 months since operation and is known to be doing well.

\*This case has been reported elsewhere and details are not given in the body of this article.



Table I—SUMMARY OF CASE REPORTS—(Contd.)

Age.	Sex.	Main symptoms.	Pre-operative diagnosis (or findings at operation).	Details of operations.	Result.	Remarks.
30	Male	Epigastric pain of two months duration with intermittent attacks of Diarrhoea and constipation.	A large Pseudo-cyst of the Pancreas. The swelling used to disappear and reappear intermittently: A large cyst extending from the under surface of the Liver down to the posterior aspect of the stomach was found.	Tapping the cyst and anastomosis of the cyst to the posterior aspect of the stomach.	Cured.	The patient had a rather stormy post-operative course. There was some infection of the cyst cavity and an inflammatory swelling presented at the anterior abdominal wall, overlying the cyst. This was incised into, when plenty of gas and some pus escaped. Through a catheter passed down to the most dependent part of the cavity 10 c.c. more of pus was drawn. The cavity was washed out with aqueous flavine solution and penicillin introduced. Thereafter the patient rapidly recovered and was discharged on 6-5-47, about 6 weeks after original operation. He was completely free from symptoms though it is too early to say that he is cured.

necessitated alternative methods of treatment and these are detailed.

4. Contrary to the usual belief pancreatic cysts are more often than not, mobile.

#### ACKNOWLEDGEMENTS

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Erskine Hospital, Madura for use of the hospital records: to Dr. Bhaskara Menon, Professor of Pathology and Dr. Narayana Menon, Professor of Bio-Chemistry of the Andhra Medical College, Vizagapatam for the various reports: to Dr. Subramanian, Radiologist, Erskine Hospital, Madura and Dr. Benjamin, Radiologist, King George Hospital, Vizagapatam, for reprint of skiagrams.

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# "EXPERIENCES IN REMOVAL OF THE THORACIC ESOPHAGUS FOR CARCINOMA."

With a report of a successful case.

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A radical trans-thoracic removal of oesophageal cancer may not be quite the rarity it was 10 years ago but the number who have survived this procedure is yet small enough to warrant publication of every single success. This is a case report of a patient who has undergone this operation and is alive one year later.

That surgery has come to stay in the treatment of oesophageal cancer is now-a-days being accepted by an increasing number of the surgical fraternity. The very low salvage rate of such patients with any other form of treatment speaks for itself and should serve as a major factor in encouraging the hesitant surgeon to persuade his patient to undergo this radical operation.

Unfortunately in India, it has been taken for granted by generations of surgeons, that the vitality of the average patient even without such oesophageal obstruction is at such a low ebb, that an operation of this magnitude has not even been considered in the scheme of treatment. This idea has gained firm ground in the minds of patients also, who have moreover been further dissuaded by ill-advised surgical opinion, to refrain from giving consent in India to this operation. As most of our patients have barely enough to keep body and soul together, and can ill afford a trip overseas to famed surgical meccas, a miserable end is thus fully assured.

Lately however, due to an increased awareness on the part of the population on this side of the globe, patients have been more willing to listen to reasoned opinion and have had faith enough to submit to such major

surgery whenever indicated and insisted upon by the surgeon. Unfortunately we find that the resectable rate is yet only 18% of the operable rate i.e. only about 18% of patients operated upon, are early enough for a resection. In 1942 a successful cardio-oesophageal resection was performed at this hospital for lower oesophageal cancer and a total resection of the thoracic oesophagus was also successfully performed. The latter patient lived for one month dying unfortunately from an acute attack of dysentery.

## DISCUSSION

(1) *Endoscopy*.—It has been a routine at this hospital to do an oesophagoscopy and obtain a biopsy if possible on all patients complaining of dysphagia. Quite a few cases which appeared on X-ray examination to be normal were proved to have small malignant growths, whereas some typical cancers on the X-ray plate have turned out to be tubercular lesions.

(2) *Approach*.—Experience with the last 4 resected cases seems to show that the right sided approach advocated by Wookey and others, definitely makes the operation technically easier. However, we found one great disadvantage, contrary to Franklin's view. The cardiac end of the stomach was out of reach when sought for after incising the diaphragm. The left sided approach is therefore the one most commonly used now-a-days. The cardia and the lesser omentum are easily approachable from here whenever it is found necessary to do so. Churchill amongst others has found, that in his experience, lymph nodes in this region are very liable to be involved especially when the lesion is in the lower 1/3rd of the oesophagus.

(3) A preliminary mobilization of the cervical œsophagus from the neck as a first step, recommended by Allison, does not seem to be of any great value. This dissection does not take more than 10 minutes after the thoracic part of the operation, provided that a thorough mobilization has been carried out from within the pleural cavity.

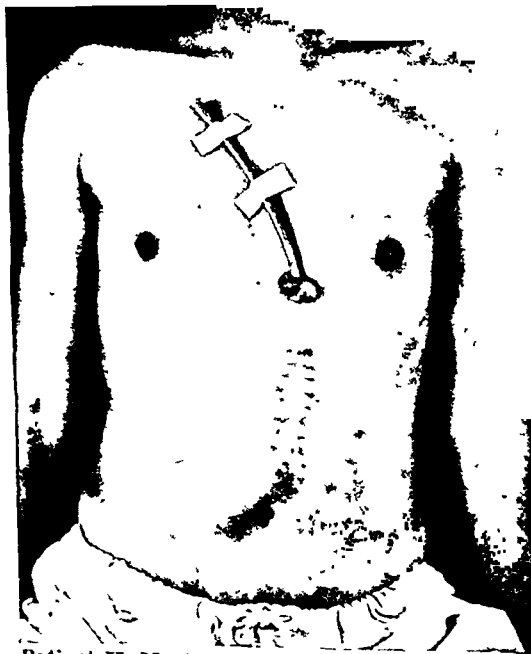
(4) Preliminary laparotomy however, but at a previous stage, is a most important step. Even when the lesion is in the middle of the gullet, Churchill has occasionally found involvement of cardiac nodes by the cancer. This region is therefore carefully inspected at the laparotomy. If there has been spread of cancer to these nodes an evaluation of respectability should be made. The liver is inspected for evidence of metastases. It is also advantageous to make a jejunostomy at this time, irrespective of the site of cancer in the gullet. If the lesion is in the lower third this procedure does not interfere with the subsequent operation of internal œsophago-gastrostomy. If the lesion is in the middle third we agree with Wookey that it is best to use the lower cut end of the œso-

phagus as a gastrostomy tube. This implantation of the œsophageal stump can be done quite comfortably after resecting the tumour at the second operation. Thus a jejunostomy is to be preferred to a gastrostomy at the first stage. As an alternative a gastrostomy may be done for mid-third lesions. Preferably a tube gastrostomy after the Janeway or Spivak method should be made. The Stamm and its modifications cannot be utilized for anastomosis at the subsequent plastic procedure of reconstruction of the ante-thoracic œsophagus. The ideal type of gastrostomy tube for this purpose is the Beck-Jianu, where a tube is actually fashioned out of the greater curvature and made to tunnel through subcutaneously, to reach the anterior chest wall higher up. (Patient Mr. V. see photograph)

(5) *Anæsthesia*.—It may be possible to operate with the simplest form of anæsthesia using the open-drop ether technique. However, if the opposite pleural cavity is inadvertently opened the patient will stop breathing. Positive pressure controlled respiration is an adequate safeguard against this complication. It also provides the surgeon with a motionless field, a condition very much to be desired at least the first few times this operation is undertaken.

(6) If no contra-indications have been met with so far the main operation is planned within a fortnight of the jejunostomy procedure. Anæmia and serum protein deficiency are made good in the meanwhile and dehydration and avitaminosis are corrected.

The tumour is approached from the left side through the bed of the 7th or 8th rib which is subperiosteally resected. After isolation and removal of the tumour-bearing area the diaphragm is divided in its tendinous part to gain access to the abdominal cavity. Cardiac nodes are again sought for and if involved are dissected out, with a wide margin of lesser omentum. If the lesion has been in the lower third it should be possible to do an internal anastomosis between the stomach and œsophagus. For this purpose the cardiac end of the stomach is freed from its omental attachments and pulled up into the thorax. We shall not go into the details of this procedure here. If the lesion



Patient II. Mr. V. Showing the Beck-jianu type of gastrostomy.

has been higher up and a sufficient length of the œsophagus is left attached to the stomach after resection of the tumour, the open end of this stump is brought out to the anterior abdominal wall by a stab wound, and implanted there as a gastrostomy tube. There is a tendency now-a-days to make an internal œsophagogastric anastomosis even for mid-third œsophageal lesions. For this purpose the gullet is dissected free from under the aortic arch and replaced anterior to it to be anastomosed with a well-mobilised stomach (Garloch) pulled up inside the thorax. We have had no experience with this procedure so far.

Drainage of the mediastium and pleural cavity is always religiously adopted. A stab is made through the 9th or 10th inter-space and a thick rubber drainage tube inserted. In the wards this tube is connected to a Wangenstein type of suction which works much better than the usual water-seal gravity drainage. The mediastinal gutter formed after removal of the œsophagus need not be closed at all. On the contrary it provides a good drainage channel for blood and exudate.

We have never used sulphonamide powder in the thoracic cavity after operation and have not yet had any trouble with empyema or alike complications. Undue importance seems to have been given to this step in most clinics. Penicillin was not freely available at the time these cases were performed. When available it should be given as a prophylactic in all cases in the post-operative period.

### CASE REPORT

#### History :

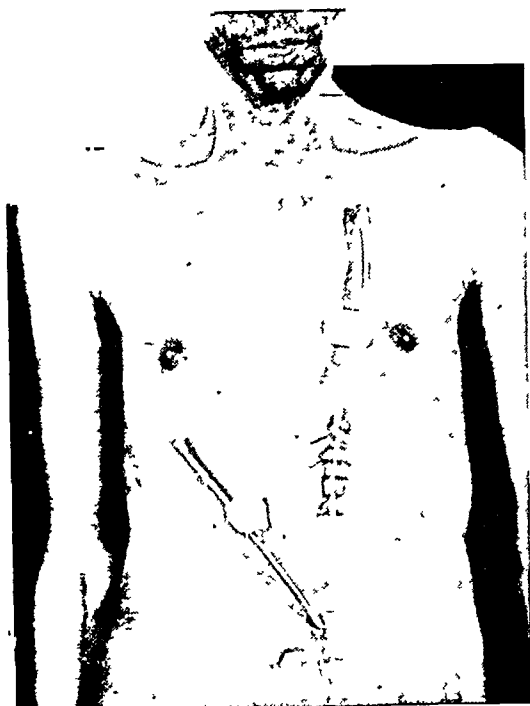
Mr. C. M. S. aged 41, a clerk; attended the clinic on 18th of August, 1945, complaining of pain in the chest and difficulty in swallowing. Solid food would stick in the gullet and cause pain in mid-chest on the right side. He was on a semi-solid and liquid diet, for 2 months. He had also noticed blood and mucous in the stools, for 15 days. On Examination: He was a tall but slender man weighing 9 stones. His colour was good. Hæmoglobin was 86%; red cells 4.8 millions and white cells 10.3 thousands. There was no enlargement of lymph nodes in the neck

or anywhere else in the body. General examination was essentially negative, except for the presence of a right vaginal hydrocele of moderate size. A barium bolus was given and a filling defect was noticed in the lower 1/3rd of the thoracic œsophagus, starting about 9 cms. above the diaphragm and extending upwards for 4 cms. A streak of barium could be seen working an irregular way through the centre of the gullet. There was very little dilatation of the œsophagus above the block and the stomach was quite normal.

Oesophagoscopy was done a few days later and at 30 cms. from the upper dental arch an ulcerating tumour mass was seen filling the lumen of the gullet. A biopsy was taken from one edge of this tumour at the same depth, and was reported to show groups and columns of a typical malignant squamous cells which were seen infiltrating through the muscle bundles. The tumour was labelled squamous carcinoma grade II. The cancer was thus at the junction of the middle and lower 1/3rd of the œsophagus and it was decided to take a chance to carry out an internal œsophago-gastrostomy, after resection of the tumour.

#### First Operation :

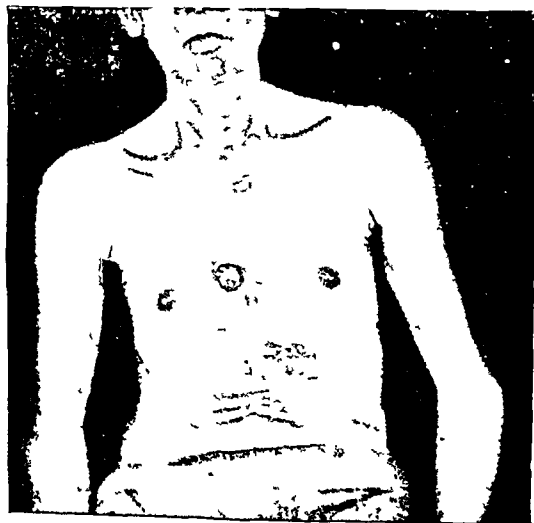
An exploratory laparotomy was performed under cyclopropane anæsthesia. The lesser omentum and cardiac end of the stomach were found to be quite free from disease. A jejunostomy was then performed and the patient brought back to the wards. He had an uneventful convalescence but his general condition was quite weak. He had improved appreciably on a good diet by the beginning of October 1945 so that on the 8th of that month it was decided to perform the main and second stage of operation. The patient was kept on the right side with the left arm extended so as to drag the scapula away with it. Endo-tracheal ether anæsthesia was started by Dr. Baldwin Faria using the CO<sub>2</sub> absorption technique of Waters and a Magill's tube with cuff. An incision was made overlying the 7th rib on the left side. Nearly the whole rib was resected subperiostially and the pleura divided through its bed. At this stage controlled respiration was started. The



Patient Mr. C. S. with the gastrostomy and jejunostomy and stump of thoracic oesophagus.



Patient Mr. C. S. The jejunostomy has closed. Tube connecting oesophagotomy to the gastrostomy. A full normal solid diet was easily taken by mouth at this stage.



Patient Mr. C. S. Showing one end of the end of the jejunum enplanted high up on the chest wall to make the subsequent stage of formation of dermal oesophagus carrier.



Patient Mr. C. S. Showing the thoracotomy scar.

chest wall was widely opened by a heavy rib spreader and the lung was deflated and held aside by an assistant standing opposite. There were a few adhesions at the lower pole of the lung. These were snipped with the scissors without giving rise to any bleeding. The mediastinal pleura was then incised 2 cms. in front of the aorta, all along the distance between the hilum of the lung and the diaphragm. The tumour was easily found just below the arch. It was decided at this stage to do a total removal of the thoracic œsophagus. By blunt and sharp dissection the gullet below the tumour was completely denuded of its surrounding tissues and held up by passing a tape around it. The vagi could not be saved and had to be sacrificed during the dissection. Very few bleeding points had to be clamped. The tumour was found to be fairly adherent to the arch but with some perseverance the whole mass was freed from its surroundings. The mediastinal pleura above the arch was not opened, but with a finger passed under the arch, the loose tissue was separated with some degree of comfort, from off the œsophagus, till it was felt that the root of the neck was reached. The gullet was then pulled down and a few vessels were still found adherent to it. These were clamped, cut and ligated.

The tumour mass was next removed between clamps. The lower stump was quite small so that it could not be used as a gastrostomy tube. It was invaginated by a continuous catgut Parker-Kerr stitch and sealed with another row of continuous Lambert sutures, using cotton thread. The upper cut end of the œsophagus was tied with tape just above the clamp which was then removed. The cut surface was carbolicised and covered with a latex sheath, the upper end of which was again tied with tape and finally transfixed to the œsophagus by a cotton stitch. This bundle was then pushed high up under the aortic arch. The mediastinal gutter was left open for drainage. An intercostal stab drain was introduced through the 9th space posteriorly to drain both the mediastinum and pleural sac. The rib-spreader was removed, and with a Lion-bone-holding forceps the ribs were drawn together by hooking the upper and lower rib in the

blades of the forceps. An assistant kept the jaws together by forcibly approximating the handles. The pleura was closed with interrupted cotton thread and the muscles were stitched in layers. At this stage the forceps were loosened and finally removed as the wound now held together. Peri-costal suturing was thus eliminated. Post-operative intercostal neuritis has been attributed to peri-costal suturing. We have never had cause to use this method of closure. The lungs were fully expanded by the anæsthetist and the inter-costal drain clamped at the end of full inspiration. Automatic breathing was resumed in a short while, after the pleural cavity was closed.

The patient was now gently turned over on to his back and an incision was made along the anterior border of the left sternomastoid. The left lobe of the thyroid was retracted upwards and to the right and the œsophagus was approached in front of the carotid sheath by pushing the trachea to the opposite side. With the help of the finger a passage was made behind the gullet and in front of the cervical spine from one side to the other. A plane was sought for similarly in front of the œsophagus and behind the trachea. The index finger was introduced in this space and carefully worked through to the opposite side. As soon as the gullet was thus freed anteriorly and posteriorly a length of tape was passed around it with an aneurysm needle and used as a retractor. The cervical fascia was snipped off the œsophagus along its lateral aspects and the index finger was then introduced into the mediastinum keeping close to the œsophagus all the time and bluntly separating it from the surrounding fascial layers. With deliberate care and patience all the attachments could be freed by the finger alone and no sharp dissection was called for. The tape surrounding the cut end of the gullet was easily felt and pulled up into the neck without much trouble. The latex covering and tape were removed. A skin tunnel was made at the lower end of the incision. The œsophagus was passed through this and made to emerge on the anterior chest wall lower down. Four cotton sutures were used to fix this end to the exit in the skin. The

cervical wound was made air tight without much difficulty and finally closed. A liberal cotton dressing was placed to absorb the saliva, and the patient returned to the ward. 500 cc. of the whole blood was transfused in the theatre. No more was given in the wards.

The pulse was moderately fast at the end of operation about 110/ minute the B.P. being 90/60. At the start of the operation the B.P. was 90/60 and the pulse 100/ minute. At the end of the 36 hours the pulse had shot up to 140 minute. There was a fair amount of moisture in the lungs so that bronchial suction had to be carried out; once, at the end of 12 hours post-operative and again after another 12 hours. He was started on Penicillin and Digalen injections, and by the end of the second day the pulse had settled down to about 100/ minute. The maximum temperature registered was 102° F. at the end of 24 hours. The B.P. never gave much cause for anxiety at any time, remaining steadily at about 105/70. An I.V. infusion of 5% glucose in water was given by drip method continuously for the first 24 hours. Not more than 2,000 cc. was however allowed in this way. At the end of 6 hours after returning from the theatre jejunostomy feeding was started in small amounts. This was subsequently increased every day, till 14 ounces were given every 4 hours by the 5th day. He was out of bed on the 15th day, and by the end of a month it was decided to perform a gastrostomy. A Janeway type of gastrostomy was performed on the 12th November. By the end of one week the Jejunostomy tube was removed and all feeds were given by mouth using a rubber tube to connect the cervical œsophagus with the gastrostomy stoma.

He came for a check up in April 1946 when a chest-plate revealed some fibrosis below the arch of the aorta. There was no evidence of the cancer anywhere else in the body.

At present he is awaiting the final step in reconstruction of the œsophagus as the gastrostomy has lately been leaking, and there is a great desire on the part of the patient to have a normally functioning œsophagus.

## SUMMARY

A case of carcinoma of the thoracic œsophagus is presented in whom a trans-thoracic removal was successfully performed. A few technical details of interest in the surgical treatment of such cases are discussed. A plea is made for insistence of surgery for suitable cases of œsophageal cancer in India.

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N.B.:—Since the last step mentioned above a further operation has been performed to facilitate the formation of the dermal œsophagus.

The abdomen was opened by a right paramedian incision and a loop of jejunum bisected 8 inches from the ligament of Treitz. The distal end was pulled upwards and made to tunnel through the subcutaneous tissues of the ante-thoracic wall and emerge on the skin as high as possible (see photograph) the proximal cut end was then anastomosed to one side of the vertical distal end by the aseptic technique of Rankin. (a form of en-Y anastomosis.)

There was some obstruction to the passage of gastrostomy feeds for the first four days, probably due to œdema at the anastomosis.

This step was necessitated on account of two factors. (1) The sparse build of the patient and (2) The sloughing out of the gastrostomy stoma.

There is very little available skin on the chest wall of this patient, and a long skin tube always runs the risk of sloughing. If the length of this tube is short the risk of necrosis is relatively diminished. By bringing a jejunal loop up, in the above manner, the length of the dermal tube need not now be more than 4 inches.



The gastrostomy will help to give rest to the newly formed junction between the dermal œsophagus and its upper and lower anastomosis, whenever that step is performed in future.

When the new œsophagus functions well the gastrostomy can be closed.

**Further note :**

1. There has been an unfortunate delay in sending this paper in for publication, but luckily this gives us a happy chance of recording 2 more successful cases operated on by our colleague Dr. E. J. Borges, where a trans-thoracic resection was carried out. Both patients are alive and well at present 2 months after the operations.
2. Since this paper was written Mr. Ivor Lewis has described in the British Journal of Surgery of July 1946 his method

of pulling the stomach up, through a dilated œsophageal opening in a right sided approach, for intra-thoracic anastomosis after resection of carcinoma of the mid 1/3rd of the œsophagus. This step should make the technical difficulties of the operation much lighter for the Surgeon, as the right sided operation is definitely easier to perform. For the patient the internal anastomosis is a great boon, *whenever possible and the absence of the aortic arch on the right side is a point greatly in favour for the performance of this particular operation for mid 1/3 œsophageal cancer.*

Our failure to reach the fundus of the stomach from the right side after incising the diaphragm, would seem, from Mr. Lewis's experience to have been due to insufficient pull on the lower end of the œsophagus.

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## "CAROTID BODY TUMOUR"

### A Case Report with a Short Review of the Literature.

By

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The Carotid Body was first described by von Haller in 1743; he called it 'ganglion minutum'. Luschka (1862) gave the first histological description and thought it belonged to the cervical sympathetic system. It is interesting to note, that, he suggested tumours might arise from this structure—a prophesy that came true about twenty-four years later when the first case was described.

The present anatomical and physiological status of the carotid body, as far as can be judged from the available literature, is as follows:—It is a bilateral organ present in all mammals. Normally it measures only 5 x 3 x 2 mm.,—the size of a rice grain—and is situated at, or near, or behind the common carotid bifurcation. Full development occurs at about the age of twenty, but, even then, it is a minute structure to be easily missed in the routine dissection, or, it may be that it does not mature fully in many individuals. The rich blood supply comes mostly from the external carotid artery, while, the nerve supply is even richer and comes from the glossopharyngeal, the vagus, and the hypoglossal nerves, and, the superior cervical ganglion. Histologically, the structure is a complex one. The chief cells—epithelium like—are cuboidal or polyhedral with eosinophilic granular cytoplasm and oval eccentric hyperchromatic nuclei; many of these cells give a positive chrome-reaction. Fibrous septa springing from the capsule divide the cell masses into cords or alveolar groups. In these septa runs the very abundant blood supply. The capillaries at some places are sinusoidal, while, at other places, the endothelium seems to form solid cords. Among the chief cells, as well as the endothelial cells, are inconspicuous ganglion cells; the presence of nerve fibres, with or without

peculiar endings, as seen in the homologous aortic bodies, is not admitted by every one. The interpretation of these histological features has led to many controversies, and these are furthered by the lack of any precise embryological data. It has been held by different observers to develop from (1) the epithelium of the pharynx, (2) the endothelium or the adventitia of the carotid artery, (3) the embryonic ganglionic cells of the sympathetic nervous system, and therefore, analogous to the adrenal medulla, and lastly, (4) Boyd's studies (1935) make him conclude that the carotid body has a dual origin from the mesoderm of the 3rd branchial cleft artery and the ectoderm of the glossopharyngeal nerve.

The same lack of agreement would seem to prevail in assigning any physiological role to this organ. Briefly stated the different view-points are: (1) they are endocrine organs—probably by virtue of their belonging to the paraganglionic system; (2) they regulate the blood pressure through a nervous mechanism; (3) they function as chemoreceptors reacting to a fall in the pH, a rise in the CO<sub>2</sub>, or, a decrease in the O<sub>2</sub> content of the blood. This last view, originally propounded by Schmidt and Comroe (1940), appears to have gathered many supporters. It need hardly be added that the functions of the carotid body must not be confused with those of the carotid sinus.

Amidst such confusion it is really consoling to find that only a single pathological lesion affecting the carotid body has been described so far—a neoplasm. Riegner (1880) was the first to remove a carotid body tumour but it was Marchand (1891) who gave as the first concise description of the neo-

plasm. Since then up to 1943 according to Goodaz and Lischer (1943) about 275 cases have been described in the literature, while Gratiot (1943) estimates the number to be not more than 250. Most observers report only a case or two, the largest individual contribution is by Harrington, Clagget, and, Dockerty (1941)—a record of 20 tumours in 19 patients.

An analysis of the published data about the carotid body tumour reveals the following features:—

(1) The Clinical History:—Most of the cases fall in the 4th and the 5th decades but the age incidence varies from 7 to 73 years. Ewing (1940) states they arise usually about puberty. There appears to be no sex predilection. These neoplasms grow slowly—very slowly indeed—so that swelling or deformity is the commonest complaint. To the examining finger the tumour is firm or soft, fairly well defined; it may show a transmitted pulsation and yield a faint bruit. The skin is free but the mass is adherent to the deeper structures and movable laterally but not vertically. Among the general symptoms noted are advanced osteomalacia (Oberndorfer, 1905) and yellow pigmentation of the skin (Reid, 1920). These may, however be coincidental. No changes in the blood pressure have been described. Pre-operative diagnosis is difficult and even impossible without the possibility of the condition being borne in mind. Phleps and Snyder (1937) estimated that out of 159 cases the diagnosis had been correctly made in only 12 and considered in 14 others. Reid (1920) recited a dictum “there is no other growth in the neck which catches, fixes, and carries the carotid artery with it”. It must be mentioned here, in retrospect, that in our case the surgeon who first saw this patient, before he came to this hospital, did diagnose it correctly. At the operation the common carotid artery may be free or compressed, or enclosed, or, infiltrated by the tumour growth. This accounts for the high operative mortality; it also accounts for the recurrences. Gratiot (1943) found 5 bilateral cases recorded so far in the literature; this bilaterality may be simultaneous or sequential. The natural history of this neoplasm varies, but, unsatisfactory records would

preclude hasty conclusions. Harrington et al (1941) recorded two recurrences, one after 8 years and the second after 10. Metastasis in the regional cervical lymph nodes is a finding accepted by all. Many cases have been reported illustrating general dissemination. Thus Gilford and Davis (1904) reported a case with metastasis in the ovaries, while, Monckeberg (1905) recorded another with nodules in the liver; but, in both these cases, according to Goodaz and Lischer (1943) the diagnosis of the primary tumour may be doubtful. Two of the patients in Harrington et al (1941) series died with cerebral manifestations; these may have been due to metastasis but the authors plainly pointed out that autopsies were not done. Cragg (1934) described a case, verified at the autopsy, of a carotid body tumour—with a similar neoplastic lesion of the organ of Zuckerkandl. In Goodaz and Lischer's (1943) case a carotid body tumour was associated with a nodule of the same tissue in the pancreas. In both these cases the authors believed the distant lesions to be merely coincidental and it would appear that no genuine case of extra-cervical metastasis is on record.

(2) The Structure of the Neoplasm:—Macroscopically, these neoplasms form rounded, usually encapsulated masses varying in size from 2 to 10 cms. in diameter, the average size being 3 to 5 cms. The usual weight is 50 gms., but, Reid (1920) has encountered the largest growth so far weighing 190 gms. The cut surface of the mass may be suggestive. It is greyish red or brown (due to chromaffin content); hyalinized septa may be conspicuous and plentiful vessels proclaim the vascularity. Microscopically, the neoplasm is composed of polyhedral cells with eosinophilic cytoplasm showing vacuoles or granules. The nuclei are oval, eccentric, sharp and usually there is more than one nucleolus. In the more anaplastic types the nuclei may be hyperchromatic, and, uni, or, multinucleated tumour giant cells may be produced. The stroma consists of fibrous tissue, acellular but always very vascular. The vessels may be sinusoidal producing cavernous tissue, or, their lining endothelium may be proliferative producing syncytial buds either projecting into the lumina, or, insinuating in between the specific tumour cells. Monckeberg (1905)

identified ganglion cells but the normal nerve fibres seemed to regress before the tumour process. Positive chromaffin reaction is irregular. It may be pointed out that the specificity of this reaction has been questioned (Gerard, Cordier and Lison (1930) and in the case of the carotid body Da Castro (1926) showed it to be due to lipoid and not epinephrin. Degenerative changes are common. In one type, the cells proper are affected, the nuclei become pyknotic or crinkled up, the nucleoli are lost, and, the cell cytoplasm becomes basophilic and vacuolated. In the other type, the stromal tissue bears the brunt; there is extensive hyalinization and this may involve the specific cells to produce intracytoplasmic hyaline bodies with ultimate merging of them into the stroma. Depending on the cellularity, the amount of stroma, its disposition and vascularity, and, the type and extent of degenerative changes etc., Harrington et al (1941) distinguished two types in this neoplasm: (1) alveolar or insular where large islands of polyhedral cells were separated by fibrous septa supporting sinusoidal blood vessels (2) peritheliomatous: wherein smaller and irregular cell units were arranged in small nests or strands separated by vascular but hyalinised stroma. Ewing (1940) pointed out the same result may be produced from central degeneration in large sheets of cells with production of cavities in which blood may be found.

(3) The Histogenesis of this neoplasm is a field for great controversy. The various names proposed for this tumour illustrate this; these are: endothelioma, perithelioma, angioma or angiosarcoma, sympathetic naevus, neuroblastoma, paraganglionoma or chromaffinoma, pheochromocytoma, carcinoid and carotid body tumour. Out of all these serious consideration may be given to the following: (1) That it is a paraganglionoma: this concept arose out of Kohn's (1903) enunciation of paraganglions as a tissue system but recent work suggests that the carotid bodies and the aortic bodies do not satisfy the criteria originally laid down by Kohn: the chromaffin reaction is inconstant and these neoplasms certainly do not secrete epinephrin. (2) That it is a ganglioneuroma: though Monckeberg did identify ganglion cells, the general consensus of opinion is that neither the nerve

cells nor the nerve fibres are actively proliferative. (3) Goormaghtigh and Pannier (1939) believe that the carotid and the aortic bodies are arterio-venous anastomoses and therefore these neoplasms are a type of glomus; this belief is extended further by Schumacker (1938) who thought the specific cells to be modified smooth muscle fibres and to secrete acetyl-choline. This theory has received no further support. (4) Kaufmann (1905) called it a hamartoma but the absence of nerve fibres in the neoplasms would negative this view-point. (5) Ewing (1940) recalling the prominent structural features of the neoplasm, would call it a perithelioma. Lastly (6) Bloom (1943) while discussing the "structure and histogenesis of the tumours of the aortic bodies in dogs" adopts Hammond's (1941) thesis that both the carotid and the aortic bodies are similar in structure, are neuro-epithelial in origin, and function as chemoreceptors. He believes that the neoplasms from these bodies should therefore be designated 'neuro-epitheliomas', but, in the present state of our knowledge, especially as the carotid body neoplasms differ in certain details from the tumours of the aortic bodies, prefers to retain the non-committal term "carotid body tumour."

## CASE REPORT

Clinical History (Case No. R/16578):—A Hindoo male, aged 22 years, was admitted for a swelling in the neck on the right side—duration 7 years. It had started as a small nodule in the upper part of the neck laterally, and had grown slowly to its present size. There was no history of pain in the region at any time. On examination he was a well built man, well nourished. Temperature 97°F; Pulse 84; Respirations 24; Blood pressure 100/70. Supratrochlear glands were palpable. Regional examination showed a rounded swelling on the right side of the neck: It extended above to the angle of the mandible below to the level of the 1st tracheal ring, anteriorly to the lateral-margin of the trachea and posteriorly just behind a line dropping down from the tip of the mastoid process. No pulsation was seen and the skin over it appeared normal. It measured 10 x 7.5 cms. The margins were well defined and the consistency was firm. The skin over it was free.

A part of the mass extended behind and beneath the sternomastoid muscle. It was adherent to the deeper structures; it could be moved laterally but not vertically. The cervical lymph nodes and the thyroid were normal. Examination of the throat showed nothing. In addition to the swelling in the neck he had three nodules on his right forearm and one in the region of the left elbow. These were of shorter duration—2 years. They were roughly circular and measured from 1 to 1.5 cms. in diameter. Their consistency was solid. The skin over them was free and they appeared to be situated in the dermis or the subcutaneous tissue. They were clinically diagnosed as lipomata. The other systems were normal. All the laboratory investigations were negative.

At the operation the mass in the neck was found adherent to the internal carotid artery and the internal jugular vein. It could not be excised in toto, and the adherent portion was left behind. The nodules over the extremities were not removed.

ed well circumscribed, lobulated, somewhat nodular, and showed all over the external surface adherent fibrous tags. At one place was seen an irregular raw area without a covering suggesting incomplete resection. There were no distended blood vessels on the surface. The consistency was firm all round. On cutting it appeared to be well encapsulated. The cut surface has a variegated appearance. Greyish white and greyish yellow homogeneous areas were seen irregularly mixed up with islets of greyish brown and dark grey. This latter tissue was mostly distributed in the cortical part of the mass. Vascular markings were quite conspicuous on the cut surface.

Microscopically (Figs. 2 and 3) (H. E. Stain) the neoplasm was covered over with a thick capsule of collagen tissue; in this could be made out hyperæmic blood vessels and a few small foci of mononuclear infiltration. From the capsule proceeded inwards thick trabeculae of fibrous tissue; they were prominent for a short distance. The neoplasm proper was

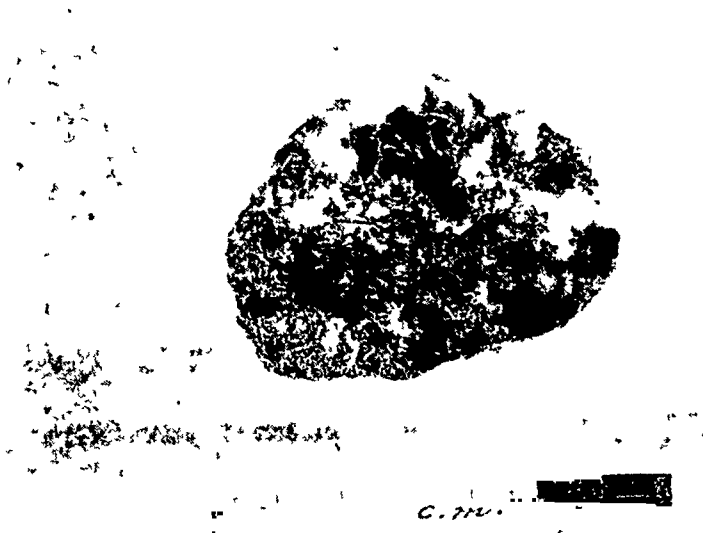


Fig. 1 To show the cut surface of the neoplasm.

#### The Specimen:—

In (Fig. 1) was an oval mass measuring 6 x 4.5 x 3 cms. and weighed 56 gms. It appear-

quite cellular. The specific cells were polyhedral and mostly of uniform size and shape. The cytoplasm was eosinophilic, finely granular

and, in an occasional cell, vacuolated; the cell margins for the most part appeared well delineated. The nuclei of these cells were round or oval with granular chromatin and most of them showed in each a single darker stained nucleolus. Some of the cells, however, were hyperchromatic, and an occasional tumour giant cell could be made out, but, no mitotic figures were seen. The cells were arranged in solid alveolar groups composed of 3 to 10 cells; but in some areas they were in short thick strands. The peculiar cellular arrangement appeared to be brought about by another kind of tissue intimately mixed with the first, but, consisting of elongated cells in two or more parallel rows, and, possessing flattened prominent nuclei. These were proliferative endothelial cells because in some portions they could be seen to form lumina containing red blood cells; just beneath the capsule they had even formed sinusoidal

lymphocytes and a few plasma cells. No ganglion cells or nerve fibres could be identified in the neoplasm proper. In the Masson's stain the collagen stroma appeared to be much more than could be recognized in the routine H.E. Stain. The endothelial cells stood out better as their cytoplasm had taken up a deep orange shade in contrast with the pale pink of the specific cells.

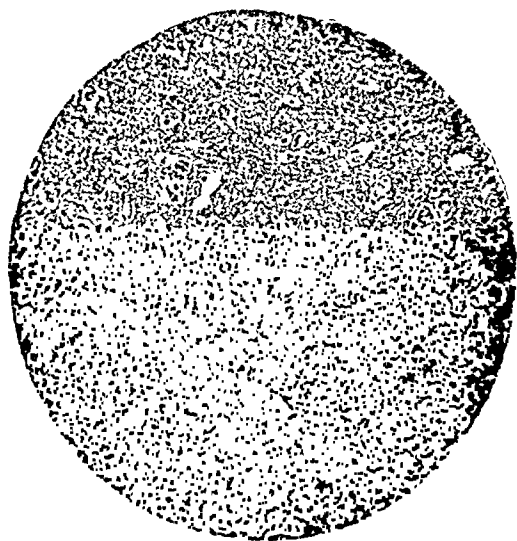


Fig. 2 To show the histological structure.  
Low Power H.E. X 100.

dilatations. So great was the proliferative capacity of cells that this endothelium had formed a few prominent islands of its own amidst which the specific cells could be made out only on close scrutiny. Hyaline degeneration was confined to the larger septa beneath the capsule. The neoplasm showed a few small foci of mononuclear infiltration—mainly

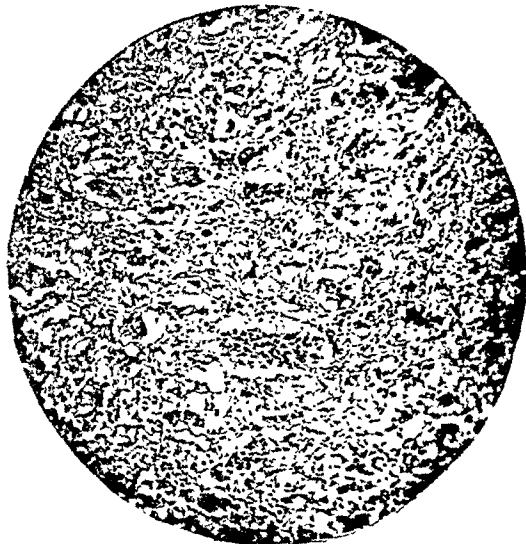


Fig. 3 To show the histological structure.  
High Power H.E. X 200.

This is the second case we have studied in our department. The first case has been previously reported by Khanolkar (1930).

#### Summary:—

1. A Case of Carotid Body Tumour is reported.
2. The relevant literature is briefly reviewed.

I have to thank Dr. K. G. Munsif for the clinical notes of the case and Prof. R. G. Dhayagude for permission to publish this paper.

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# MALIGNANT NEURO-FIBROMA OF THE NECK IN A CHILD AGED NINE YEARS

By

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MALIGNANT tumours of the neck are varied in character depending upon the tissue they arise from and also the anatomical situation. Malignant tumours generally occur in the lymphatic tissue in the neck. This may be primary in character or may be secondary deposits from primary growths on the head, in the nose, in the mouth, in the larynx or in the pharynx. Thyroid tumours are common and some of them may turn malignant. Sometimes malignant tumours arise from the branchial rests giving rise to the brancheogenic carcinoma. Carotid body tumours have also been reported some of which may turn malignant. Nerve tumours are rare and they may be of the type of neuro-fibromas or neurinomas which may be sessile, pedunculated or plexiform in type. The sessile and pedunculated types may be small or big in size. The plexiform type is the more serious type of tumour because it insinuates between the brachial plexus and the nerve bundles and the tissues round about. The other types of connective tissue tumours are rare. Some of the neuro-fibromas may turn malignant from the start or may become malignant after repeated attempts at removal behaving in the same way "Recurrent Fibroma of Paget." The following case illustrates a neuro-fibroma which was benign to start with, became finally malignant after repeated removals.

A Hindu male boy, aged 9 years, was admitted on 16-5-38 for a tumour in the neck with a history of two years duration. At first a small swelling was noticed in the left anterior triangle about the size of a marble which ultimately grew to the size of a lime within a period of six months. This was removed by operation in his own native place, but it recurred some days later along the line of the incision. Later he was treated by indi-

genous methods by the application of an ointment which resulted in ulceration. On admission, a big tumour about the size of a large orange extending from the trachea laterally to the left over the sterno-mastoid encroaching upon the posterior triangle of the neck overhanging the clavicle and upwards to almost the level of the angle of the jaw and the lobe of the ear (see pictures Nos. 1 and 2).



Fig. 1

There was another tumour on the right side which appeared separate from the one on the left side at the level of the thyroid cartilage. The skin over the tumour on the right side was pink in colour and tender to the touch. On the left side, the skin was ulcerated in places with irregular margins and nodulated and the skin over the nodule was found to be stretched and soft to the touch. The tumour was mobile in front in the mid-line and posterior triangle of the neck. The patient was anæmic, the heart borders were



normal but there was a systolic murmur in the mitral and the pulmonary area. Blood

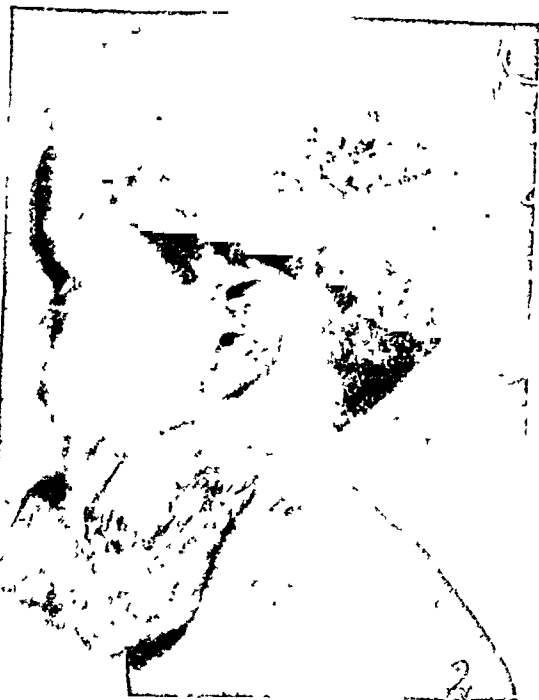


Fig. 2

showed anæmic changes, R B.C. being 2.5 millions. Wassermann was negative. He was treated for anæmia, and later on 7-7-38 a biopsy was done. The discreet tumour on the right side was removed for biopsy. Bleeding from the thin walled vessels was difficult to control and therefore sub-cutaneous ligatures were applied to control the hæmorrhage.

On histo-pathological examination, the section proved to be a benign fibroma. Based on this report, on 28-7-1938, under Ethyl Chloride Ether Anæsthesia (intra-tracheal) a complete removal was done. The structure was found adherent to the sterno-mastoid. A portion of the muscle with the platysma was sacrificed. It was diagnosed as a case of neuro-fibroma at this operation and had numerous prolongations along the brachial plexus. A large raw area resulted after the removal of the tumour and later on the 16th of August 1939 a Thierch's Skin Graft was used to cover the raw area and the patient was discharged relieved.

On histo-pathological examination the report stated it to be a case of cellular fibroma

with a few tubular and glandular structures on the surface of the growth covered by the skin. The glands were apparently the sweat glands caught into the advancing margin of the tumour.

The patient was again admitted on 21-11-1938 for small lumps below the clavicle over the sterno-mastoid in the region of the posterior triangle of the neck (see picture No. 3). On 29-11-1938 the posterior triangle was again explored and what looked like a plexiform neuro-fibroma was removed and the raw area was again successfully skin grafted on 27-12-1938.



Fig. 3

The pathologist's report stated that it was a soft fibroma showing myxomatous change. On one side there was a foreign body surrounded by a number of giant cells. In one place, fragments of the foreign body, possibly ligature material, could be seen. The patient was discharged relieved.

He was again re-admitted on 11-10-1939. At this time, there were two nodular swellings on the right side, two on the left side and one in the midline. They were all of different sizes varying from the size of a pea to that of a marble with an extensive scar in the region of the neck more on the left side and extending into the infra-clavicular

fossa with slight wry neck. The swellings were firm in consistency. Again an attempt at complete removal was done and after



Fig. 4

removal the histo-pathological examination stated that it was a vascular tumour with thin walled vessels and the cells showed mitotic figures with a suggestion of early sarcomatous change, had undergone myxomatous change and showed nerve bundles, fat cells and whorl formation. The patient was radiated using a radium collar surface application with a total dosage of a thousand milligram hours.

On follow up, in reply to a letter dated 20-7-1943 his father has written as follows:—

"My son Gangadhara Rao who was operated for tumour of the neck on 28-7-1938 died of the same complaint on 26-11-1941."

#### Points of Interest:

(1) A tumour in the neck arising from the nerve tissue extending over a period of 5 years is reported.

(2) This was in a child aged 9 years. 7 operations for removal were done of which one was done in the mofussil. Of the others, one was a biopsy, three were complete excisions followed by two skin grafts. The last complete excision was followed by radium application and the result of the follow up shows that this is a radio-resistant tumour.

(3) A study of the pathologist's report is interesting as it shows the gradual change from a benign growth to a malignant condition. The fact that it was malignant growth was confirmed by the follow up report that the child died of the same disease.

(4) This case is interesting because very few cases of neuro-fibromas undergoing malignant changes in the region of the neck in children, are reported in literature.

#### LIST OF ILLUSTRATIONS

1. Is a clinical photograph showing the antero-posterior view of the tumour.
2. Is a clinical photograph showing the lateral view of the same tumour.
3. Is a clinical photograph showing the result of the operation and showing the recurrence in small nodular forms as seen in the picture.
4. Is a histological picture of the section of the tumour. Shows spindly cells with mitotic changes.

# MESENTERIC THROMBOSIS AND EMBOLISM

By

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A Hindu lady named "B" aged 40 years was admitted in the Thompson Hospital on 7-10-46, with the following complaints:—

1. Pain all over the abdomen—Duration one year.

2. Heart-burn and chronic constipation—Duration one year.

3. A lump appearing in the upper part of the abdomen soon after meals followed by vomiting—Duration 15 days or so.

**Clinical signs and symptoms:**—The patient could not digest any food and whatever she used to take, was followed by spasmodic pain and appearance of a lump in the abdomen. Vomiting used to occur within half an hour or so of taking of the meals, and it was followed by marked relief in the abdominal pain. She had been progressively losing weight for the last one or two months.

On physical examination she appeared slightly anæmic and weak. **Abdomen**—on inspection showed a sunken appearance with visible aortic pulsation. On administration of fluid or milk there was a visible peristalsis in the epigastrium and a spherical lump of the size of a tennis ball used to travel from left to right. On palpation nothing abnormal was detected.

All other systems were normal, except the heart which was slightly enlarged to the left nipple line, with a systolic murmur in the mitral area, conducted slightly to the left axilla. Pulse rate was 70 per minute. Blood-pressure systolic 105 m.m. of H.G. and diastolic 65 m.m. of H.G. The following investigations were done:—

1. Blood—total R.B.C. 4 million per c.m.n.  
H.b. percentage.—10 grams per 100 c.c.

Total W.B.C. count 6,800 per c.m.m.

Differential W.B.C. count—

Polymorph 76 per cent.

Lymphocytes 24 per cent.

Monocytes 0 per cent.

Eosinophil 0 per cent.

Basophil 0 per cent.

P.C.V. 38 m.m. %, M.C.V. 95 c.u.—M.C.

H. 25 r.r.—M.C.H.C. 26%—Color index .7  
Stool—Normal.

Blood Urea—34.2 m.g.m. per 100 c.c.

Fractional Test meal—fasting juice 25 c.c., mucous present in all specimens. Acid curve—normal.

**X-ray:**—Barium meal examination—Showed marked dilatation of stomach, with delay in the passage of meal, which was found in the stomach 24 hours afterwards. Diagnosis—Pyloric obstruction.

**Pre-operative preparation:**—Gastric lavage was done daily for about 6 days. Intravenous normal saline 100 c.c. and Glucose solution 25 per cent 100 c.c. was given daily for four days.

**Operation notes:**—The abdomen was opened and the stomach was found to be dilated with obstruction of the Pylorus by a small hard mass.

No other abnormality was detected and a posterior no loop Gastro-Jejunostomy was done. The whole operation was done under general anaesthesia (open ether) in spite of the fact that the patient had heart disease. Further progress was uneventful, the stitches were removed on the 10th day. She began taking milk and fruit juices and could digest them better than before.

On the 21st day she took her usual glass of milk at night and after about half an hour

got severe pain in the abdomen and back. She vomited the milk she had taken and began tossing in bed in severe agony. Her body was cold with perspiration and the pulse was imperceptible. The blood pressure could not be recorded due to severe collapse and pulseless condition of the patient.

She was given morphia  $\frac{1}{4}$  grain and atropine 1/100 gr. Intravenous saline 200 c.c. and 25% glucose 100 c.c. was given rapidly through a syringe. The pulse rate returned but was slow and weak (56 per minute). Blood pressure returned to 110 by 70. On examination of the abdomen there was no tenderness or rigidity. Next morning the pulse was again hardly perceptible and she developed slight distension and fulness of the abdomen with pain all over. Both the recti muscles were rigid. Operation was decided upon and under local anaesthesia laprotomy was done. Intravenous saline 800 c.c. with 5 per cent glucose was given during the course of the operation. On opening, the abdominal cavity was found full of blood-stained effusion. The gastrojejunostomy opening was perfectly in order with adhesions all around. A loop of small intestine 1 foot long was found congested and oedematous lying freely in abdominal cavity. The mesentery of this loop was also congested with extravasation of blood between its layers. Resection of the infarcted loop of bowel with a few inches of healthy bowel above and below was performed, thus removing a total length of about 18 inches and lateral anastomosis of small intestine was done. The patient was given rectal saline and a slow continuous drip of glucose saline transfusion after the operation. The pulse which had remained imperceptible throughout the operation gradually returned and the blood pressure ranged between 110 and 90 systolic and 90 and 65 diastolic every day after the operation. One pint of intravenous saline with 5 per cent glucose was given daily for about 5 days. The patient made an eventful recovery except for very slight sepsis in the abdominal wound. She had a course of Penicillin 500,000 units after the operation and six injections of Cibazol ampoules.

pale patches of infarction on the external surface. The bowel is soft to feel. Microscopic examination—There are extensive areas of necrosis, degeneration and hæmorrhages. The epithelium has practically disappeared and the glands have either atrophied or disappeared. Small round cell infiltration is present. Endarteritis obliterans of the vessels of the superior mesenteric artery is present.

**Histological diagnosis:**—Infarction and necrosis of the bowel.

**Discussion:**—This patient was suffering from heart disease *i.e.* mitral regurgitation and probably the embolus originated from the left ventricle which travelling through the systemic circulation blocked one of the branches of the superior mesenteric artery. Thrombosis must have extended from the site of embolus into the various branches which were also diseased thus causing infarction of 12 inches loop of the bowel. Even after resection of the loop along with the mesentery there was no further extension of the thrombosis in other branches of the artery as accounted by the uneventful progress of the case after the operation. Endarteritis obliterans of the vessels predisposed to the thrombosis in the mesentery, which extended up to the terminal arcades or vasarecta leading to infarction.

The only hope of her recovery was resection of the bowel which was done under local anaesthesia in her extremely shocked and collapsed condition. Her condition immediately improved after the operation but she had to be kept on intravenous saline infusion almost daily for one week to prevent any recurrence of thrombosis and maintain her vitality; as blood transfusion was not available it could not be given. She had extreme lack of appetite and could take very little substantial nourishment by mouth. She liked fruit juices very much and could digest them. At the time of her discharge she was taking sufficient quantity of milk, vegetable soup and fruit juices. There are no recent statistics regarding mesenteric thrombosis and embolism, as the condition is not diagnosed easily and the operation is sometimes not possible owing to the collapsed condition of these cases. A. J. Cokkins collected 92 cases

**Pathological report of the loop of intestine:**  
—A loop of small intestine red in colour with

from two London Hospitals and he has described the condition in some detail.

Arterial occlusion is usually the result of embolism the source of which is the heart, either endocarditis or some other valvular disease, lungs in pyæmia or the arteries with atheromatous plaque or ulcer. Primary thrombosis rarely occurs. Superior mesenteric vessel and its branches are equally affected. If the main trunk of superior mesenteric artery is blocked there may be infarction of the whole loop of small intestine and death. The result of embolism is complete stoppage of circulation with venous engorgement due to back flow in the mesenteric veins from portal circulation. Infarction and gangrene ultimately occurs. If one of the branches is occluded collateral circulation keeps the loop alive but secondary thrombosis extends up to the terminal arcades or *vasarecta* leading to infarction. This was the pathology in the case illustrated where only 12 inches of the bowel was affected with the effects of circulatory obstruction of a small branch of the superior mesenteric artery. The inferior mesenteric artery is rarely blocked.

Venous thrombosis is usually the result of infective condition in the abdominal cavity, for example, a case of suppurative appendi-

cititis may lead to pylephlebitis. Portal obstruction may also predispose to venous occlusion.

**Diagnosis:**—The clinical picture is of acute obstruction with internal hæmorrhage accompanied by marked shock and collapse. There may be hæmatemesis or *malæna* which is reported to occur in 50 per cent of cases. Mr. Cokkins suggests a diagnostic enema which when given before the paralytic ileus sets in discloses the effusion of blood in small bowel.

There may be evidence of free fluid in the abdomen which shows an appearance of fullness.

The only hope of survival of such cases is by immediate laprotomy and resection of the infarcted loop which can be removed up to 15 feet in length. The diagnosis is confirmed on opening the abdomen when a blood-stained effusion is seen to escape out.

Mr. Cokkins' series of cases showed a total mortality of 83 per cent but where resection was performed it was 50 per cent.

I am thankful to the Superintendent Dr. G. N. Vyes, M.D., M.R.C.P. for allowing me to publish the case record.

# OCCIPITAL MENINGOCELE—CASE REPORT

By

Major D. KANAKA SABHESAN, M.S. (Mad.), FR.C.S. (Edin.), A.I.R.O.,  
Professor of Surgery, Andhra Medical College and Surgeon, King George Hospital,  
Vizagapatam.

A Hindu female child aged 2 months was admitted on 6-10-46 with a big globular cystic pedunculated swelling 4" in diameter over the lower part of the occipital region of the scalp in the middle line. This child was the 5th child to her mother.

The swelling was noticed at birth as a small soft swelling which gradually increased to its present size. The skin over it was thin, tense, shiny and showed numerous fine vessels crossing over it. It was translucent and appeared incompressible. There were no associated congenital-defects in any other part of the body. There was no ulceration of skin surface.

The child's general health was good.

X-Ray examination did not visualise clearly any defect in the occipital region of the scalp.



Fig. 1

The child was put on penicillin treatment 15,000 units every 3 hours from 13-10-46. The child was operated on 16-10-46 under local infiltration anæsthesia with ½% novocaine. The sac was dissected all round by



Fig. 1-A

an elliptical incision and then traced to an opening in the occipital bone which admitted the thumb easily; during this manoeuvre there was a small puncture into the sac. The redundant scalp tissue and overlying skin were excised. The bulk of the sac had to be cut away for want of room inside. The rest representing the stump about 1" from the root was closed by a continuous silk suture and the stump shoved into the skull. The defect in the skull was closed by raising flaps formed from the surrounding musculo-aponeurotic scalp tissue and the scalp wound

closed by overlapping its upper edge over the defect and sewing it low down to the lower margin of the scalp. The skin wound was closed without drainage.

Penicillin was continued for 4 days more. The patient made an uneventful recovery.

Clinical photographs of the child before and after operation and the X-Ray print *not* showing the defect in the skull are herewith enclosed. The case is reported on account of its unusual size and the smooth post-operative convalescence presumably due to (1) local anæsthesia; (2) penicillin umbrella.



Fig. 2



Fig. 2-A

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# CONSERVATIVE TREATMENT OF FRACTURE OF PATELLA

*By H. AHMED, Calcutta.*

The treatment of fracture of Patella has undergone changes in recent years. It has been the time-honoured custom to suture the fragments of Patella by chromic catgut, silver wire, Kangaroo-tendon, etc. But Brooke suggests that the Patella serves no useful function in swift moving animals and so advocates excision of Patella. In all methods of treatment immobilisation of knee (slight flexion) and quadriceps muscle exercises are the main principles.

Herewith I narrate a case where fragments of Patella have united firmly by conservative method (Adhesive plasterbandage followed by plaster of paris and quadriceps muscle exercise.)

Case:—A male patient aged 25 years was admitted in Calcutta Police Hospital with

history of sudden fall on hard ground. Examination revealed transverse fracture of Rt. Patella with hæmarthrosis—the gap between the fragments was nearly half inch. He was put in adhesive plaster bandage and was prepared for operation. Due to unforeseen circumstances (communal riot in Calcutta) operation had to be postponed till 28-8-46. On the day of operation it appeared the union had taken place. He was immediately put in plaster with knee in slight flexion. Plaster was removed on 28-9-46. He left the hospital walking on 6-11-46 (about 3 months after the injury). He has been seen again on 6-2-47. The union is perfect and gait is normal.

X-Ray plate of 9-8-46 shows fragments of fracture Patella.

X-Ray plate of 1-11-46 shows the union.

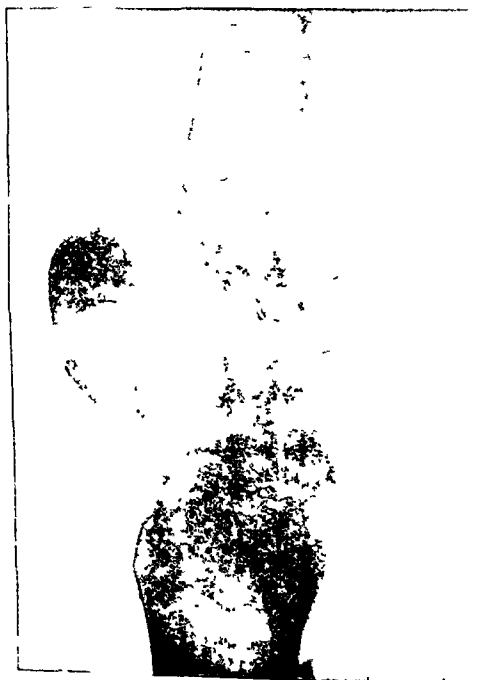


Fig. 1



Fig. 2



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### THE VIIIITH ANNUAL CONFERENCE.

The 8th Annual Conference of the Association of Surgeons of India was held on the 27th, 28th, 29th and 30th of December, 1946 at the King George Medical College, Lucknow and was, as usual, a great success. Dr. S. B. Gadgil of Bombay presided and Rao Bahadur Capt. K. S. Nigam was the Local Secretary. He was helped by a group of student volunteers from the Medical College. Arrangements made for the accommodation and transport of the visiting members left nothing to be desired. Lucknow, with its historic background and fame for its courtesy to strangers, cordially welcomed the Association, and the Visitors were impressed by the hospitality extended to them by everyone.

The formal inauguration of the Conference took place at the Convocation Hall of the King George Medical College, Lucknow, on 27-12-46 at 9 a.m. The Hon'ble Mrs. Vijayalakshmi Pandit, Minister for Public Health, U.P., declared the Conference open. In her inaugural address she said:

"I am glad to associate myself with this Session of the Annual Conference of the Association of Surgeons of India. I have great faith in the power of the healing knife and am eager to see the Science and Art of Surgery come into its own in our country. We have unfortunately developed the habit of living on past glories and are apt to forget that the future is of greater importance than the past. This has been a harmful factor in our progress. While it is true that the art of Surgery existed in India at a date almost lost in the oblivion of historic records, it is equally true that today we are far behind the Western countries in the advances that have been made in the field of Surgery. It is, imperative, therefore, that we become more conscious of those causes which are responsible for our backwardness and that we look forward rather than backward, for inspiration.

It is not for me, a lay person, to speak to you, distinguished Surgeons from all parts of the country, on this subject, except to emphasise the fact that in the new India, which is being born, your part will be one of great responsibility. Our political freedom means or should mean the building up of the Nation in all forms of human endeavour in which the art of healing and the education of the masses will play most important parts. The renaissance in the political field must also be accompanied by renaissance in the fields of social and national activity and your contribution towards this will be of great value to India.

In the field of Science and Medical Research especially, we must subordinate everything to larger interests and work not only for the glory of India but for the Service of Humanity".

# THE EFFECTS OF WARS ON THE EVOLUTION OF SURGERY

*Presidential Address by Dr. S. B. Gadgil, B.A., F.R.C.S., L.M.S., F.C.P.S.,  
D.P.H., Bombay.*

In asking me to preside and address you to-day at the 8th Annual Meeting of the All India Surgical Association you have conferred on me a signal honour for which I desire in the first place to thank you. Next I have to thank on your behalf the distinguished Minister of Public Health who has found time to open this Conference and address us with her mature ideas and experience. Thirdly I have to thank those who have worked hard and made these excellent arrangements for holding this Conference in this historic and ancient city of India.

This Association represents the only post-graduate body of the practising Surgeons in this country. We have come here with a desire to learn from others their experiences and at the same time make our own work known, maintain and tighten the bonds of unity, amity and esteem as members of one profession and of one nation at its great renaissance. This has been made possible due to our use of one common language as a medium of communication for our thoughts and ideas in social, political, economic and scientific atmospheres, not only in this country but also in the international world. Let us not be in a hurry to abandon this English language until we have developed our own Hindustani so that every person from Peshawar to Cape Comorin thinks it as essential to know Hindustani as it is now to know English. English is at present best suited for scientific expression of ideas in international world on account of its precision, terseness and richness of its vocabulary, the last of which I consider is not possessed at present by Hindustani. I also consider it somewhat ungrateful on our part to abandon in a hurry the help this language has given us and made us acquainted with world thoughts on Democracy, Socialism, Fascism, Nazism, Bolshevism and other isms and their subtle differences. It is through this language that a Punjabi, Tamilian, or Maharashtrian has learnt to feel that our culture is the same and as such our nationality should be the same. For

advancement of science again it would be a retrograde step for the present to teach scientific subjects like Medicine, Surgery, Chemistry, Zoology, Philosophy by books translated in Hindustani with an altered nomenclature based on Sanskrit, Persian or Arabic for current scientific words. It is the lawyer politicians who are ultra political but infra scientific who ask you to sing this hymn of hate against the English language. Even now the Russians, English, French and Italians insist on their students to know thoroughly one of these languages in addition to that which is their mother-tongue and why should we discourage its teaching in such a hurry. The late Justice Ranade had once remarked that it was providential dispensation that brought us in touch with the English people and their language ultimately to be of benefit for the people of this country, and he was right no doubt from what we are seeing at present. I will dilate no more on this subject except to say "Do not drop this pilot in a hurry as far as scientific progress of this country is concerned, and follow the Irish people on this point".

Leaving this question of language aside I come to the question of wars which as you are aware are condemned by everybody. Are we Surgeons as men of science entitled to do so? Have these wars done nothing for the evolution of Surgery and thus become useful to humanity? Plato has wisely said that the world is really foolish in not understanding that men are always at war with each other. Montaigne states that wars are considered always the greatest and most magnificent of human actions. This is proved at the present time by Surgeons, who have returned from the last war after performing some military duties, sticking to their military ranks as Captains, Majors, Colonels, and Commanders as if their important work consisted not in aiding humanity in their misfortunes by their kind attention as healers of wounds, but in holding certain ranks in fighting units of the army.

If they really abhorred wars they would never have used their military ranks in civil life but would have considered a greater honour to be called merely "Doctors". They will never do that. The pomp and circumstances of wars have captivated the human mind so much so that its horrors are deliberately minimised, and conquests made after battles have more attention paid to them than those gained by Satyagraha and Ahimsa. Even accepting things as they are, man who dominates nature so much descends at times below the level of an animal to wage a relentless war on his own species as we find in Calcutta, Behar, Noakhali, Bombay and South Africa in preference to turning his immense knowledge gained from nature against the most potent of his enemies, viz., Bacteria, ignorance, bigotry and religious intolerance. These have caused more deaths than powder and bullets. This is due to the savage instinct or virtue which comes to the top in case of disagreement to decide "Can I kill thee" or "Can you kill me". This makes wars necessary till we have conquered this savage beast in our own self. I must say we are still in the infancy of civilization.

Because of the lack of knowledge of an average surgeon in historical matters it seems appropriate to give you here a brief resume of the evolution of Surgery due to wars of different periods, advantages gained by humanity and the prestige the Surgeon has acquired as observed from records of authentic history.

Surgery has been rightly called the Queen of Medical Art though a sub-committee of Association for alterations of the rules and regulations of this Association would like to call it a science of Surgery and not an art. Its history is coeval with the history of mankind. The first surgical operation was probably that of extracting arrows received in combat and healing of wounds received in hunting wild animals. The term Dhanvantari in India probably meant a man proficient in curing people injured by Dhanushya. He represents Aesculapius of Indian Medicine.

There was fair amount of Surgery in ancient Egypt 5,000 years ago as found by researches carried out on Egyptian Mummies. In South America a collection of Peruvian

skulls shows distinct signs of their being trephined apparently for headaches also in prehistoric period with surgical instruments fashioned from stones. In Greece, Surgery found a fertile soil to flourish 2,000 years ago due to constant waging of wars there among the tiny local governments and against Persia, when Greece became Imperialist and wanted to conquer the whole of Asia. Fifty years before the birth of Hippocrates, Surgery is said to have flourished in Greece. Hippocrates treated with success diseases of bones and joints, fistulas and trephined skulls and repaired defects left by nature in completing its job. He removed stones from bladders and treated hæmorrhoids. His achievements in Surgery no less than in medicine placed medical science on sound basis. It is stated that Polemy was killed while being trephined after his fall from a horse on the battle-field.

Arabs carried the torch of medical science during the period 800 A.D. to 1350 A.D. They translated the works of Hippocrates and Galen and made some original researches in drugs derived from mercury and sulphur. They built big hospitals in Bagdad, Damascus, Mansur hospital at Cairo and at Cardova in Spain. Albucasis in 1013 wrote a book on Surgery. Avazoor (1113 to 1193) found the cause of Scabies. Paul of Aegæan was a surgeon who treated diseases and foreign bodies in ear, nose and throat and invented tracheotomy operation. In 1190 they were able to get permission to do dissections on dead bodies to learn Anatomy, one body being allowed to each physician every five years. Upto that time it was considered by Christians and Muslims both an unholy act to dissect a dead human body. Dissection of animals was also considered to be a low occupation not to be followed by a respectable profession. Knowledge of Anatomy became more accurate due to the studies of one Peter of Avano studying at Padua and Arnold of Villa Nova of Montpellier Universities respectively in 1250 A.D. Medeno of Bologna commenced his researches in finding drugs to cause sleep in patients before operation. Lucca made some additions to these drugs in 1258 A.D.

The science and art of Surgery in India can be traced to the same period as that of Hip-

pocrates if not earlier. Atreya was a great physician at Taxilla University and Shushruta a surgeon at Kashipeeth or the ancient Benares University. Both of them flourished before the 7th century B.C. The Physician Charak was at the court of the Buddhist ruler Kanishk in 100 A.D. Shushruta long before had described the Anatomy of the human body as studied on human cadavers and has given a list of surgical instruments needed for major and minor surgical operations. Indian Medicine and Surgery flourished till the 12th century A.D. when the chief surgeon at the court of Muhamad Ghory was a Hindu Physician the father of Wachaspati who had summarised all the medical and surgical literature existing at the time i.e. 1250 A.D. The art of printing being not in existence the copies of such books were scarce.

Eye diseases were studied at Naland in Behar and ninety-four diseases of the eye have been described in the various Sanhitas.

According to writer Arrain Greek soldiers accompanying Alexander the Great in 327 B.C. thought very highly about the abilities of the physicians and surgeons in India at that time. But for all this it is a pity that these Unani and Ayurvedic methods of treatment of diseases based not on the knowledge of Anatomy, Physiology and Pathology as we now understand but based solely on empirical bases should be encouraged after a hibernating period of eight hundred years in this century, instead of leaving them for research by medical graduates for obtaining a post-graduate degree and thus obtain for us all the useful knowledge to be found in those systems.

We owe to the Romans the foundation of Ambulance work. It was the Roman General Labianus who made arrangements for his wounded to be carried in waggons drawn by swift horses to Admentium, a seaport, for surgical treatment in North African Wars, with attendant male nurses.

We also read that Saladeen, the Muslim conqueror, after his conquest of Jerusalem allowed the Christian Knight Templers to look after the wounded crusaders about the year 1200 A.D. The wounded used to be

looked after first by women and then by the surgeons. This was the real beginning of the St. John Ambulance Service. Arabs were at the height of their scientific attainments at this period.

Due credit for the proper establishment of the ambulance service goes to a lady, Queen Isabella, the Catholic Queen of Spain, who established Ambulance and Military Hospitals on modern lines in the years 1483 to 1487 in Spanish wars against the Moors. Tent hospitals for the sick and wounded furnished with attendants and medicines were established by her at her own expense. There were 400 ambulance waggons with her when the victorious Spanish troops entered Granada. Four large hospital tents with careful provision of all kind was a sight worth seeing. Wounded as well as the diseased were taken care of and the order, diligence and supply of all articles necessary and useful were as complete as in the best hospitals of Milan at that period.

The Queen herself went round the hospitals to talk to the patients and when advised to keep away from them said "Let me go to them for they have no mothers. It will soothe them in their pains and weakness to find that they are not uncared for." Here we find an example for ladies of our country to visit hospitals more frequently after calamities causing serious injuries resulting in deaths more frequently. Improvement in military hospitals and ambulance service continued as one war succeeded another, as the number of fighting men increased from thousands to millions. As the quality of brutality, maiming and mutilation got more and more refined, thanks to the advance of science in war, the surgeons also became more and more efficient in the treatment of such cases with the help of the same progress in science.

An International agreement was signed by several European powers in 1863 where it was agreed to treat medical personnel and severely wounded cases as neutral due mainly to the efforts of a Swiss gentleman Henri Dunant who had seen the good work of Florence Nightingale and had visited the battle-fields of Crimea and Salferino, where the wounded were left on the battle-field unattended for

several days without food or water. Dunant lost his whole fortune working for 25 years in this philanthropic work and had to live in obscurity from 1867 to 1901 when his merit was recognised. He received the Nobel Prize and further honours. To honour the country whose national flag was a white cross on a red ground the red cross flag was instituted with a red cross on a white ground. This is the origin of the Red Cross movement. I am unable to state why the red crescent was adopted for such work. Conditions as regards treatment of the wounded before this time was very bad indeed during the Napoleonic wars. We read about this from the account written by the great surgeon Ambrose Pare. He went to a stable in Milan after the French entered that city to keep his horses and found there, four dead soldiers and three dying propped up against a wall on grass strewn on the floor. They neither saw, heard or spoke. Their clothes were smouldering where gun powder had burnt them. While Pare was observing this an old soldier comrade walked in and asked if there was any hope of saving them. When he heard that there was no hope, the soldier went and gently-cut their throats. When remonstrated he replied I hope I will find some kind person to do the same to me under similar circumstances. It seems these stables were more safe to the wounded than the military hospitals which were not free from enemy attacks in those days, though no fire could be lit there to keep the place warm on account of grass lying on the floor.

Non-existence of any trained personnel to look after the wounded in the armies of the Indian States with their wars with the British and French must have been one of the causes of the wholesale desertion of the soldiers after a crash on the battle-field resulting in their defeats, though their armies always outnumbered those of the British and the French.

In my opinion these constant wars among the nations of Europe and the experience gained there has been the main spring for the improvement of health and morale of the population there. The people there have improved physically and mentally. We have equally degenerated being robbed of our ini-

tiative, manhood and pride of race. It will be a great day for this country if we gain experience by military training in all our schools for the want of which much irregularity, indiscipline and want of team work are noticed at present in all our activities.

With this training, one can be of greatest use to humanity, in places where large gatherings of populations such as jattras, melas, uruses take place and where sanitary arrangements, supply of food and clean water and preventive methods such as vaccinations, inoculations and first-aid measures after accidents are to be carried out. The efficiency of all these depend upon the regulated experience made on disciplined material mobilised for wars or some other similar purposes.

To resume our subject viz., the evolution of Surgery. After Hippocrates comes the name of Galen of Alexandria. His contribution to Surgery consisted in ligaturing of arteries, suturing of nerves and other operations on brain and spinal cord which were made all in the wars of the time. He also wrote a book on Human Anatomy.

Bruno de Langoburg helped to clarify the meaning of the term Surgery in his book *Chirurgica Magna* in 1252 A.D. He stated that the essentials of Surgery consisted in bringing separated parts together, separate those that had gone united together and extirpate those which have got superfluous.

Lanfranc was also a surgeon of the 13th century. He was for abolishing distinction between medicine and surgery.

Henri de Modeville was his pupil. He was not at all satisfied with the Surgery of his time. He said that surgeons of his time know how to cause suppuration than how to heal a wound.

Taglia Cozzi made rhinoplasty operations for repairing noses popular. They were often cut off by the order of the Pope for sins considered to be mortal in this period of ignorance and religious intolerance.

Guy de Chaliac was the first in those days who started using extension apparatus for

fractures in addition to splints. He also used moulding by bandages soaked in white of egg as a hardening agent where we now use plaster of Paris.

Ambrosé Pare was a great surgeon at the time of Napoleon. His experience was gained at Hotel Dieu in Paris and as a military surgeon he treated with success wounds caused by swords, pistols and firearms of the time. He described different varieties of fractures including those of skull. He was the inventor of artery forceps, artificial eye and various other surgical instruments. He first drew attention of the relation between syphilis and aneurysm. He introduced ligatures instead of boiling oil to stop hæmorrhage after amputations and this saved many valuable lives.

William Salicets is another name to be honoured. He distinguished between Arterial and Venous hæmorrhages. He tapped hydrocephalus by cautery points and made other researches.

Wars have been of benefit to the progress of Surgery but I do not mean Surgery would not have progressed and remained stagnant without wars. The discovery of æther as a general anæsthetic by the dentist Morton in 1846 was not made under war conditions. This year is the centenary year of this great discovery and æther is still holding its own as a general anæsthetic. For 500 years previous to this discovery, a powder made from mandigora opium hyoscyamus and camphor was used for inhalation when soaked on wet sponge. Hugh of Luce was its inventor. He insisted on cleanliness in Surgery. Pre-Listerian Surgery advanced due to the discovery of æther as an anæsthetic but it was characterised by the presence of Pyæmia, Septicæmia, Erysipelas and Hospital gangrene.

Researches of Pasteur leading to the discovery of the cause of fermentation made Lister think that a similar phenomenon by minute organisms was the cause of suppuration. His studies to prevent the growth of such organisms in tissues in cases of compound fractures at Glasgow made possible the use of Carbolic acid for dressing Compound fractures and resulted in diminishing sepsis from the wards of that hospital. He

was able to convince the great men of Surgery of that period of the efficiency of his method. Thiersch and Volkman from Germany, Billroth from Vienna and Lucas Championere from Paris were impressed with his results and the position of antiseptics in Surgery was thoroughly established.

Brain operations were tackled with more and more confidence. The first operation for removal of the Gasserian ganglion successfully was performed by Sir Victor Horsley using antiseptic technic. I have had the torture of watching this great ambi-dextrous surgeon performing brain operations while a continual douche of antiseptic lotion was being used to keep the parts free from blood and now 10 per cent of brain tumours are found amenable to Surgery. There were some tragedies on account of the over use of antiseptics. They were used not only for dressing of wounds or for disinfection of materials used at operation but also for saturating the air of the atmosphere of the operation theatres with carbolic acid vapour with disastrous results. Lawson Tait came on the scene at this period. He performed ovariectomies and other abdominal operations under aseptic conditions with success. Rubber gloves for the use of surgeons came into general use in the beginning of the present century.

Though this advance and progress in Surgery was not due to war conditions, the present period of war has made such progress that the medical history of the future will have to say of the last two wars more than any of the preceding ones for giving Surgery a powerful stimulus for its advancement as you will presently notice.

It was the South African war which opened our eyes to the fact that only 8,000 people were killed by bullet wounds while 14,000 died from Typhoid, Dysentery and other bacillary diseases, and the importance of inoculation and vaccination as a prophylactic was established due to the researches of Sir William Wright, Haffkine and other scientists.

In the Russo-Japanese war, which took place soon after, the Japanese took full advantage of these discoveries. Inoculations

against typhoid and tetanus were carried out resulting in the lowest death-rate during that war by these diseases.

We now come to the 1st Great War of 1914-1918 where machines and mechanics of destruction were still more developed. There were hardly any cases of Typhoid or Tetanus in this great war worth making a special report for improvements in the treatment of these diseases.

A great deal of work by Crite and others was carried out in America regarding treatment of Shock. Stress was laid on Anoci association and loss of fluid from general circulation. During this war shock was treated with saline solutions and also with Gum acacia solutions given intravenously. Transfusion of blood was used though rarely and use of prepared plasma for transfusion was practically not known.

Wounds commenced being treated with Dakin's solution given continuously by Carrel tubes inserted in the depths of wounds when very septic and Bipp paste was often used to pack wounds with, to keep them free from contamination and also for its antiseptic value with good results. In later stages of the war, debridement of wounds with primary suture came into vogue, all with still improved results.

Injuries due to shrapnel, mines and bombs were extensive resulting in crippling of human beings. Sir Robert Jones recognised the number of such wounded disabled by compound or simple fractures and took it as a challenge given to surgeons to bring them back as useful members of society. With his exceptional skill and knowledge combined with marvellous capacity and ability for organization he met with success which is well known. He established the first military hospital for Orthopædic Surgery with 200 beds leading to 33,000 beds for such cases in England and America.

Plastic Surgery for injuries to face and jaws with their hideous deformities were successfully dealt with by surgeons like Gillies and progress in this art now is phenomenal.

Coming to the present war it is now possible with an air of finality to survey the progress in Surgery and Medicine during the last six years. Scientific progress made in war enabled patients being carried from India to England supplied with artificial breathing apparatus. Air transport for taking patients from the battle-field to hospitals across the sea was freely used. Problems physiological and psychological in persons left in atmospheres they were not used to live have been attended to and solved.

The development of resuscitation therapy for the prevention and treatment of shock, replacement of fluid therapy for the maintenance of blood pressure in seriously wounded men has also been an interesting chapter of this war. On the base of knowledge gained before the war as regards the properties of blood plasma and serum in the prevention and treatment of shock it was deemed advisable to select dry plasma as the agent of choice for use in resuscitation of the seriously wounded and hospitals were supplied by authorities with the necessary quantity of plasma for use in the beginning.

During the war it was found that plasma while valuable as a first-aid measure in combating shock did not give favourable results, compared to those noted following the administration of whole blood in severely injured cases. This observation made the British organization feel the need of whole blood for transfusion. Units to provide adequate amount of whole blood were started actually in the theatres of war.

Americans soon arranged for blood banks in the different hospitals from donors on active service and supplied the needed amount of blood. By the middle of 1944 on account of the realization by the services the value of the whole blood as a therapeutic measure lead to the development of a programme which provided shipment by air of large quantities of whole blood from U.S.A. both to Europe and Pacific battle fronts in containers kept at 40° Fahr. of such blood. About 86,000 pints of blood were supplied to the Pacific region alone. I have no doubt, blood will be needed in large quantities and would be ready

in the next war as plasma was kept ready in the last war unless some other fruitful discoveries are made to replace some other fluid instead of blood. The values of serum albumin and fibrin ferment products is a further development. Serum albumin has been found useful in severely burnt cases to reduce œdema after salines have been given intravenously.

Only 25 grammes of serum albumin gave results corresponding to 1 unit of plasma, i.e. 300 c.c. Thus serum albumin was found to be superior to prepared plasma in such cases. Fibrin ferment foam has been found useful for arresting hæmorrhage.

Sulphonamide and other sulpha drugs though useful when given in adequate doses by mouth in preventing infection of wounds seems to have very little influence in preventing sepsis when applied locally, notwithstanding that one hears glowing accounts concerning the value of sulphonamides thus used in preventing infection on such cases.

As regards Penicillin, not only the antibacterial quality of this drug discovered by the researches of Florey and Flemming has been confirmed by the extensive use made against the pathogenic bacteria and cocci of all varieties, but credit has to be given to the pharmaceutical, chemical and distilling industries of America for producing this drug in quantities, which in pre-war time would have been thought fantastic and incredible.

Properties of Penicillin and similar products like Streptomycin in saving life and limb and its role in the care of wounded must be considered in conjunction with other adjuvants of surgical therapy such as Plasma, Serum Albumin Amigen products, whole blood and sulpha drugs given intravenously.

The death-rate among the wounded in this war has been 4.4% compared with 8.25% in the war of 1914-18 among the Americans. It is interesting to know that the death-rate among the Germans wounded was 10% in the first four years of war, while they were winning all their battles. This has been mainly due to pre-operative, operative and post-operative improvements in the treatment of

the wounded by the Americans and English Surgeons.

To demonstrate how the ingenuity of surgeons assisted by researches in science has been able to cope with wounds of lower extremities involving the main blood supply, viz., the deep femoral or the popliteal artery. This resulted often in amputation of the limbs. All attempts to save the limbs by ligaturing the torn vessels or by arteriorrhaphy failed due to firm œdema of the muscles rapidly causing structural alteration that was hard and unyielding. This prevented collateral circulation and generally ended in gangrene of the limb. Some success was obtained in the last war when the French Surgeons used Tuffiers vaselined silver tubes to carry on the circulation and Germans did the same by end to end anastomosis by Carrel sutures or by bridging the gap by a venous graft.

Americans have contributed to this Surgery devising venous lined sutureless Vittalium tubes. But these tubes are not always available in emergencies.

The following case reported in the American Journal of Surgery is interesting as to what could be attempted in such cases. The patient reported after injury to the deep femoral after a great loss of blood with blood pressure of 50 m.m. mercury instead of 125 m.m. 2,500 c.c. of blood was given by transfusion. This raised his B.P. to 104 m.m. and the injured ends of the divided vessels were tied. Lumber Sympathectomy was now carried out as the extremity still remained cold and gangrene was threatened. The result was that the B.P. came down again to 67 m.m. from 104 m.m. but the extremities remained warm. Another 1,500 c.c., i.e. 50 ounces of blood was transfused. This resulted in establishment of the circulation and saved the life and limb as well, of the patient. 4,000 c.c. of blood, i.e. 135 ounces or 6½ pints was needed for the purpose of this treatment for the want of which many of the early deaths in the hospitals due to esanguination must have taken place. This treatment has come to stay and would be successful if blood banks have been established in hospitals all over the country.



A great deal was learnt in this war as regards the technic in the treatment of compound fractures and in cases suffering from burns avoiding discomfort to the patients by daily dressings. The horizon of work of the surgeons is enlarged due to experiences in treating results of destructive effects of explosive shells, fragmentation of bombs, torpedo attacks, buried ground mines and grenades. Attacks came from not only land but also from sea and air. The surgeons have thus gained experience in remedying and reducing the mortality caused by visceral wounds besides wounds of extremities.

The early education of a surgeon is in character merely an apprenticeship which leads to some dogmatic views. The sharing of experiences with surgeons from other schools of thought from different continents, when working together in properly supervised theatres of war has exerted a broadening influence on the intellectual growth of surgeons. Recognition of distinguishing qualities in persons not of their country or colour, when working on similar injuries and accidents or diseases moderates racial pride, breeds tolerance and often creates esteem and respect for people of other nations and colour.

This list of the benefits rendered to the humanity by wars will be incomplete unless a statement is made in short of the other equally important benefits given to the civil population now that the war is over, though Surgery may be interested in them only indirectly. Dusting the bodies with D.D.T. powder for delousing purposes has made people so dusted immune from Typhus when living in the midst of a population suffering from Typhus epidemic. D.D.T. is a personal and environmental insecticide presents one of the most advanced preventatives not only against Typhus but when used as a spray, it has been able to control flies, mosquitoes and their larvæ which are destroyed by its use. Needless to say that it has prevented all diseases whose germs are spread by the mosquito agency, such as malaria and yellow fever.

The rat despite all old methods has multiplied and has become destructive all over the world and a constant menace to health. Two

effective agents likely to replace all others have been developed during the five years of the war. One is known by Antu and the other Sodium fluoro acetate. Both are acceptable to rats and are rodenticides without causing injury to higher animals.

The discovery of quinacrine, a drug superior to quinine, was made by Germans due to monopoly of the Dutch Cartels, which controlled the world market of quinine. When Germans found difficulties to obtain sufficient quantity of quinine in the last world war they discovered chloroquin which causes abrupt termination of the clinical attacks of malaria in only a day or two. Further development gave us Atabrine or Quinacrine, Pamaquin and Paludrine.

The drug B.A.L. British Antileusite was also discovered during this war. It is a therapeutic agent against the local and systematic action of certain Arsenical War gases and arsenical poisons. It is found useful in the treatment of Dermatitis and Encephalitis caused by an overdose of maphersan.

Considerable quantity of Gamma Globulin is produced in the preparation of Serum albumin. This globulin is found to be useful in ameliorating the attacks of measles and protects against infective hepatitis.

A formalized vaccine against influenza has also been discovered which confers immunity against this dreaded disease which carried away millions of people after the last war.

Glycol vapour from 1 gramme of the drug has been found highly effective in sterilization of several hundred millions C.C.S. of air from pathogenic bacteria attacking respiratory passages and could be used in hospitals by a proper oiling of floor mixed with the drug and thus prevent the dreaded pneumonia and other respiratory diseases.

A new era of physical science has developed by the discovery that atom, hitherto believed to be indivisible, has proved to have a structure of electrical components held together by a complex force. It has an external electronic atmosphere and an internal nucleus which has been explored leading to modern knowledge of atomic energy.

With the electron microscope and ultra centrifuge hopes are maintained that significant information will be available regarding the ultimate constitution and fine structures of living matter and a new era for the ultimate control of life processes is not far off.

By strongly irradiating the germinating seeds, by X-Rays a new type of tobacco plant with a 13 ft. long leaf has been produced. Ovums thus irradiated are likely to have great alteration of some of the genni resulting in change of the biological character of the offspring of such an ovum.

Machines of a million voltage are comparatively recent developments. X-Rays produced by machinery of lower voltage by their attacks on the cathodes have been used for 30 years for treatment of superficial cancers, but their penetrating power is low. Rays of a million voltage are to be used not for creating X-Rays by attacking the cathode of metal but by making diseased tissue act as a cathode.

Cathode rays or electrons produced by five million volt machines are liable to penetrate the body when exposed to it to a depth of one inch, where they produce their maximum results. It is hoped that electrons thus produced will be useful in treating deep seated cancers.

I have said nothing so far about the researches made by Russian scientists and surgeons in this war. They concerned mainly in grafting of tissues obtained from healthy soldiers recently killed in battles on other individuals deprived of the same most successfully. Eyesight are improved, contractures of limbs prevented and functions of organs have been restored by these researches.

The last two wars have been distinguished by more humane considerations for the rehabilitation of men of the fighting units. Nothing was done for them in the wars of early centuries except granting them a miserable pension.

The medical profession has always heartily assumed the responsibility placed upon it and in meeting which discoveries and advances

have been made to maintain the humane objective of alleviation of pain and suffering and restoring men as rapidly as possible in order to retain their services as trained men. But no one can deny that the records of the success in providing assistance towards a satisfactory adjustment to civil life for those who are discharged for physical disabilities from the army are still very poor. No encouragement has been given to such men that though they are handicapped they are not disabled for life. In the past rehabilitation of such men was left to men themselves, but now the problem of readjustment of such men has been accepted by Governments of the various victorious countries. The rehabilitation starts while the patient is in the military hospital, while under treatment and is complete when he is ready to leave the hospital.

This programme consists of physical therapy, occupational therapy, physical training and vocational education useful in civil life in discharged men not able to carry on their original occupation and confidence is created in them that they can take a useful place in the community in which they live.

Who can say after all these facts that wars have contributed nothing for the good of humanity or it is a wind that blows nothing but evil.

If I may be allowed to indulge here in a little politics I may make myself bold to say that these European Wars have awakened in us our national pride. It has made us think of the whole of India as one nation instead of a continent of so many Balkan States each forming a nationality according to the language in that province. We still need one common language though there may be many different linguistic provinces. Conditions which conduces to the thoughts that India is one country needs besides one common language one national head-dress and one national-anthem which will be sung by Hindus, Parsis, Muslims or by members of any religion and not listened to like a sermon in a church. With the help of our brain and brawn and brilliant tradition of bygone days in our mind we are sure to become one day a great nation.

After the Presidential Address by Dr. Gadgil, the Hon'ble Pandit Govind Ballabh Pant, the Premier of the United Province accorded to the Surgeons of India a hearty welcome to Lucknow on behalf of the Government of the Province. Declaring open the Surgical Research Exhibition, he said that he looked to them for co-operation and assistance not only in the progress of the Science and Art of Surgery but in extending relief to millions of sufferers, and hoped their assistance would help in the alleviation of a part of the misery. Surgery, he said, has had an important place in human pursuits from the day men learned to live.

Humanity, continued Pandit Pant, was grateful for the great assistance eminent Surgeons had rendered during periods of human degradations which resulted in Wars. But every cloud had a silver lining and Wars had contributed a good deal to the Science of Surgery. Wars which had brought in their trail destruction and human degradation in the World had also given a filip to the Science of Surgery. He referred to the U.S.S.R. where great researches had been made by the Russian Scientists during the course of the War. He also stressed that researches should not be confined to the Laboratories only but should be tested in a wider field of alleviating the pain of the suffering humanity of this country.

The Premier added that successful Surgery depended much on perfect instruments and expressed the hope that sufficient progress would be made in India in the manufacture of good instruments and that they would be able to work without instruments being imported from abroad.

He felt sure that the Exhibition would make its own contribution towards this end.

Capt. Nigam, the Local Secretary, welcomed Dr. Gadgil and the Delegates of the Conference, and thanked Mrs. Vijayalakshmi Pandit for inaugurating the Conference and the Hon'ble Pandit Govind Ballabh Pant for opening the Exhibition.

The usual group photo of the members of the Association was then taken.

In the evening Raja Bishwesh Seth, Vice-Chancellor of the Lucknow University, gave an 'At Home' which was attended by the Hon'ble Pandit Pant, members of the Association and others.

The first Governing Body meeting was held at the Medical College at 10-30 a.m. on the same day under the Presidentship of Dr. S. B. Gadgil. Eleven members were present. Minutes of the last two G.B. meetings were read by the General Secretary and they were passed. 26 new members proposed during the year were duly admitted.

The Ballot papers for the Election of the Governing Body were scrutinised and counted.

It was noticed that the members present either in person or by Proxy would not constitute the two-third majority of the members on the rolls required for amendments and alterations to the Rules and Regulations. In view of this fact, the proposed alterations and amendments could not be passed. It was, therefore, decided that at the General Body meeting convened for the purpose, a general discussion on the amendments proposed be held in an informal manner so as to ascertain the views of the members present and to postpone final passing of these amendments to a later date, when attempts would have been made for a more adequate representation.

The usual Dinner of the Association was held at the Carlton Hotel. The Hon'ble Pandit Govind Ballabh Pant and Sry. Vijaya-Lakshmi Pandit, who were to be among the Guests of Honour, could not come at the last moment. The Guest of Honour was Raja Bishwesh Seth. The toast of the Association was proposed by the President. Dr. Nigam proposed the toast of the Guests and the Vice-Chancellor replied. The toast of the Reception Committee was proposed by the Secretary and he paid a glowing tribute to the work done by Dr. Nigam and his Reception Committee. The dinner was a grand success.

Films on Modern advances in Anæsthesia were exhibited at the Elphinstone Picture Palace, specially arranged for the members of

the Association of Surgeons of India through the courtesy of the Bombay Surgeons.

Discussion on the three main subjects fixed for the year was held in the afternoons.

Visits to various Hospitals in the City had also been arranged and demonstrations of operations on the Gall Bladder, Thyroid, etc., were held.

The first General Body meeting to discuss the amendments to Rules and Regulations of the A.S.I. was held in the evening. About 45 members were present. Dr. S. R. Joglekar, Convener of the Committee appointed to consider the amendments to Rules and Regulations, read out and explained the alterations suggested by a few members. There was some helpful discussion though nothing could be definitely passed on account of want of the requisite two-thirds majority.

A meeting of the Editorial Board was also held during the Conference. The name of Dr. Joglekar was proposed in the place of Dr. V. L. Parmar and the same was passed.

#### THE ANNUAL GENERAL BODY MEETING.

The 8th General Body Meeting was held on 30th December 1946 at 4 p.m. at the Convocation Hall of the King George Medical College, Lucknow, Dr. S. B. Gadgil of Bombay in the Chair. More than 40 members were present.

After the opening remarks of the President a condolence resolution touching the untimely demise of Drs. B. C. Patwardhan of Jamkhandi State, R. P. Dalal of Ahmedabad and Lt.-Col. F. H. Whyte of Simla, was passed all the members standing.

The Secretary then read the minutes of the last General Body meeting and the annual report for the year ending 31-12-46 and they were unanimously passed.

The Secretary announced the results of the election to the Governing Body. The following 11 members who had obtained the highest number of votes were declared duly elected to form the new Governing Body:—

1. Dr. B. N. BALAKRISHNA RAO, Mysore.
2. „ S. K. SEN, New Delhi.
3. „ U. MOHAN RAU, Madras.
4. „ M. R. MUNAWAR ALI, Hyderabad.
5. „ M. D. PATEL, Ahmedabad.
6. „ V. P. MEHTA, Bombay.
7. „ B. M. SUNDARAVADANAN, Madras.
8. „ H. Y. KHWAJA, Bombay.
9. „ G. M. PHADKE, Bombay.
10. „ N. S. NARASIMHAN, Madras.
11. Col. SANGAM LAL, Madras.

The President then read the nomination papers submitted by Drs. B.N. Sinha and R.N. Cooper proposing the name of Dr. M. G. Kini as the next President. He also read the nomination paper submitted by Drs. A. E. deSa' and E. J. Borges proposing the name of Dr. S. R. Joglekar of Bombay to the Presidentship of the Association for the ensuing year, but as Dr. Joglekar withdrew his nomination, Dr. Kini was unanimously elected as the President for 1947.

Dr. R. N. Cooper invited the Association to hold the next Conference at Bombay. Dr. Menon, the Secretary, informed the House about the invitation from the Patna University to hold the 1947 meeting at Patna. The majority of the members present expressed a desire to hold the next meeting at Bombay, and it was unanimously decided to postpone the invitation from Patna for 1948, confirming Bombay as the venue for 1947 Conference.

Drs. V. P. Mehta and A. E. deSa' were elected Local Secretaries.

After the concluding remarks of the President the Secretary expressed on behalf of the Association its appreciation of the excellent way in which Dr. Gadgil the retiring President, had conducted the affairs of the Association during his term of Office. The Secretary thanked Mrs. Vijayalakshmi Pandit and the Hon'ble Ballabh Pant for their kind words of encouragement. He also thanked heartily the Local Secretary and his Student Volunteers for their efforts in making the Conference a grand success.

The new Governing Body met at 6-30 p.m. at the Carlton Hotel the same day, Dr. M. G. Kini, the new President, in the chair. A few members who were proposed during the Conference were admitted.

Dr. S. K. Sen proposed and Dr. V. P. Mehta seconded that Dr. N. S. Narasimhan of Madras be elected as the next Vice-President of the Association and he was unanimously elected.

Dr. V. P. Mehta proposed the name of Dr. B. M. Sundaravadanan of Madras as the next Treasurer. Dr. S. K. Sen seconded and he was unanimously elected.

In view of the fact that no Madras member of the newly elected Governing Body was willing to accept the Secretaryship of the Association, the Governing Body, under the powers vested in them by Rule 16 of the Rules and Regulations of the A.S.I., by a resolution proposed by Dr. M. G. Kini, seconded by Dr. S. K. Sen and passed unanimously, requested the retiring Secretary, Dr. C. P. V. Menon, to continue as Secretary for one more year.

With a vote of thanks the meeting terminated.

#### 9th Meeting:

##### 1. Bone Tumours—

Opener: Dr. D. R. Meher Homji,  
 Secunder: Rao Bahadur Dr. M. G. Kini, Madras.

##### 2. Intracranial Tumour—

Opener: Dr. A. V. Baliga, Bombay.  
 Secunder: Dr. R. N. Cooper, Bombay.

##### 3. Burns—

Opener: Dr. M. R. Munawar Ali,  
 Hyderabad.  
 Secunder: Dr. P. K. Sen, Bombay.

#### 10th Meeting:

##### 1. Spinal Tumours—

Opener: Dr. R. G. Ginde, Bombay.  
 Secunder: Dr. R. N. Cooper, Bombay.

##### 2. Talipes Equinovarus—

Opener: Dr. R. Kalamegam,  
 Trichinopoly.  
 Secunder: Dr. M. Bahadur Khan,  
 Hyderabad.

##### 3. Surgical Complications of Typhoid—

Opener: Dr. V. G. Vaishampayan,  
 Sholapur.  
 Secunder: Dr. A. V. Baliga, Bombay.

#### 11th Meeting:

##### 1. Treatment of Elephantiasis and Lymph Oedema:—

Opener: V. P. Mehta, Bombay.  
 Secunder: T. Kanakaraju, Ramachandrapuram.

##### 2. Treatment of Hernia with Fascial Grafts and Silk Sutures:—

Opener: P. Chatterjee, Calcutta.  
 Secunder: S. K. Datta, Calcutta.

##### 3. Treatment of the Bone Cavities in Chronic Osteomyelitis:—

Opener: D. K. Sabhesan, Vizagapatam.  
 Secunder: B. N. Sinha, Lucknow.

### PRIZE ESSAY ON "SURGICAL ASPECTS OF AMOEBIASIS"

The Association of Surgeons of India offers an annual prize of the value of Rs. 150 to the best essay based on original work on 'Surgical Aspects of Amoebiasis.'

The following are the conditions of the award:

1. The competition is open to all qualified medical practitioners registered in India, who have been in practice for not more than 10 years after qualification.

2. The Essay should be based on original work and should be written in English.

3. It should be typewritten on one side of the paper only and should not contain the name or other indication of the identity of the competitor. Four copies should be submitted.

4. The name, address and qualifications, however, should be written on a separate sheet of paper and enclosed with the essay.

5. The subject is 'Surgical Aspects of Amoebiasis' and the essay should reach the Secretary before the 1st October, 1947.

6. The copyright for the winning essay will remain with the Association of Surgeons

of India and will be published in the Indian Journal of Surgery. Other essays will be returned to the senders if accompanied by stamped addressed envelopes.

7. The Governing Body may at its discretion withhold the prize if the essays submitted do not come up to the standard.

8. All communications regarding the above are to be addressed to the Secretary, Association of Surgeons of India, 'Binfield,' Kilpauk, Madras.

C. P. V. MENON,  
Secretary.

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## CANCER OF THE RECTUM

By

*E. J. BORGES, M.S., F.R.C.S. (Eng.),  
Surgeon, Tata Memorial Hospital, Bombay.*

Cancer of the rectum constitutes 1% of cancer recorded at the Tata Memorial Hospital which is devoted chiefly to the treatment of neoplastic disease. Unlike many cancers it is comparatively easy of diagnosis because it produces symptoms early and occurs in an accessible portion of the body. Unfortunately these symptoms are so akin to such relatively common complaints as piles, fissure and chronic dysentery that both the patient and his medical advisers are often misled. The word cancer has such a ring of doom that doctors hesitate to pronounce it until it is too late. This is perhaps excusable because in this country it is not yet generally realised how much can be accomplished in the treatment of early cancer. One therefore welcomes this opportunity of initiating a discussion on rectal cancer at this meeting of the surgeons of India and recording the great strides that have been made in its treatment.

At the Tata Memorial Hospital 113 cases of this disease have been recorded in the five and half year period from March 1941 to September 1946, and this paper is based mainly on a study of these cases and our experiences with them.

In the time at our disposal it is impossible to speak of cancer of the rectum from all its aspects, and so we shall spend most of the time available in discussing the treat-

ment. But it would be well to make a few preliminary remarks about some of the other aspects that we think may be of interest.

### COMMUNITY INCIDENCE:

The incidence in the various communities is as follows:—

Hindus	..	..	60
Muslims	..	..	24
Parsis	..	..	9
Indian Christians	..	..	14
Europeans	..	..	6

These patients have come to us from various parts of India and the figures do not represent any particular cross section of the population. The percentage attendance of the different communities at our hospital is 5,000 cases was:—

Hindus	..	..	63.38
Muslims	..	..	26.2
Christians	..	..	5.8
Parsis	..	..	2.4
Non-Indians	..	..	1.8

Although the number of rectal cancers is too small to assess the correct community incidence, a comparison of the two sets of figures suggests that cancer of the rectum is fairly evenly distributed among the communities in India.



**AGE INCIDENCE:**

Youngest patients	..	17 and
		18 Years
Oldest patients ..	..	85 "
25-29 Years ..	..	2 Cases
30-39 " ..	..	13 "
40-49 " ..	..	39 "
50-59 " ..	..	33 "
60-69 " ..	..	19 "
70 and over ..	..	5 "

The highest incidence occurs in the fifth and sixth decades. In England and U.S.A. the highest incidence is in the sixth decade.

It is curious that both the youngest patients were Muslim youths of the Borah community and both had advanced colloid cancer.

**SEX INCIDENCE:**

There were 84 males and 29 females in this series, giving a ratio of 3 males to one female.

**ETIOLOGY:**

One is very much impressed with the importance given in foreign literature to benign polyps of the rectum in the etiology. Yet in a large experience of proctoscopic and radiological investigations of bowel disease at this hospital one has been no less impressed by the rarity of polyps associated with bowel lesions. Only three cases of multiple polyps were discovered in over two hundred investigations. Cancer arising in a polyp occurred only once and that was in a European woman. Our impression is that rectal polyposis is infrequent in this country. I should like to hear from you if your experience has been the same.

**DIAGNOSIS:**

When adequately treated in its early stages rectal cancer is curable in such a high percentage of cases that it is a pity that almost half of our patients (51 of 113) came to us in a hopelessly advanced condition, and most of the others after some period of delay. The patient himself was to blame in 63 cases out of the 113, and the doctor shared the responsibility with the patient in the other 50 cases. No patient arrived within one month of the onset of significant symptoms, and only 8 patients came within three months. A diagnosis of piles made by the patient himself and sometimes confirmed by the practi-

tioner leads to the use of fraudulent patent medicines and sovereign remedies advertised in the lay press, until the condition is fairly well advanced. Many of those that escape a diagnosis of hæmorrhoids as readily fall victims to intensive courses of emetine and other anti-dysenteric measures.

For some reason or other there appears to be a great aversion on the part of many physicians to inserting a palpating finger into the rectum. I wonder if they feel that such base practices are better left to us surgeons. In our collection, most of the cancers (95 of the 113) occurred in the lower segment within easy reach of the finger, where they could easily have been diagnosed if this method of examination had been done. In 6 instances even eminent physicians, for whose competence I have the highest respect, went astray because digital examination or a barium enema was inadvertently omitted. This only emphasises the point that a rectal palpation is essential in all cases of bowel symptoms, and that it is unwise to continue treatment if symptoms do not abate, or recur, without excluding the possibility of cancer by proctoscopic and radiological examination.

We shall not go into the clinical features of rectal cancer as they are well known to all of you. We shall only stress that suspicion once raised must be confirmed or eliminated by proctoscopy and biopsy. This should be repeated at least once if negative. It is important to exclude chronic inflammatory lesions, of which there are so many in this country. Nineteen patients referred with a diagnosis of cancer turned out on biopsy to be chronic inflammatory ulcerations and strictures. A biopsy also helps in deciding the prognosis and treatment. The controversy whether a biopsy carries a risk of dissemination has long been settled, though there still appears to be apprehension in some quarters. The routine adoption of biopsy in cancer clinics has not affected the cure rate adversely; rather it may be said that it has contributed to the great improvement in the results obtained by permitting earlier diagnosis and more scientific treatment.

**PATHOLOGY:**

We shall not take up time in discussing the pathological aspects of rectal cancer. We

shall barely record the histological types seen by us. Of the 113 cases 26 were not biopsied. The rest fell into the following groups:—

1. Adeno-carcinoma	..	43
2. Squamous carcinoma	..	33
3. Adenoma malignum	..	6
4. Colloid carcinoma	..	4
5. Myosarcoma	..	1

There is a much higher incidence of squamous cancer of the anal canal in our series than in records from other countries. Bacon<sup>1</sup> gives the figures for adeno-carcinoma and squamous cancer as 83% and 6% respectively. Gabriel at St. Mark's finds squamous cancer to be 3.5%. Why we have more squamous cancers is a matter for speculation and further study. We should like to have suggestions on this point from you all.

### PROGNOSIS:

Excluding the inoperable cases in whom the prognosis is bad, the outlook in operable cases has been found to rest on the following two features.

(1) The anatomic spread of the disease. Cuthbert Dukes' classification<sup>2</sup> of these cases into A, B and C groups depending respectively on whether the lesion is confined to the rectal wall, or has penetrated into the perirectal tissues, or has also involved the lymph nodes, is too well known to need further elaboration. Suffice it to say that the out-look is faithfully represented by the group into which any particular case falls. Group A yields 84% cures; Group B 62%; and Group C 31%<sup>3</sup>.

In our series of 30 radical resections the incidence in the three groups was:

A Group	..	..	8
B Group	..	..	11
C Group	..	..	11

(2) The histological character of the lesion does to a lesser extent indicate the ultimate fate awaiting the patient. The grade 3 and 4 lesions and the colloid cancers are apt to disseminate early and widely and so are less amenable to cure.

### TREATMENT:

One is happy to embark on a discussion of the treatment of cancer of the rectum without striking the same note of pessimism that one is forced to adopt when speaking

of malignant disease in many other situations. A 5-year cure rate of 90% as reported by many clinics in the very early cases, is indeed something to be jubilant about. The only thing that detracts from the brilliance of these results is that the treatment involves the sacrifice of the rectum and the establishment of an abdominal colostomy which, whatever we may have to say for it, is apt to be regarded by the patient himself as one of the worst trials of the flesh. Of recent years there has been a growing tendency following the work of Babcock of Philadelphia to offer the patient a perineal colostomy with preservation of the sphincters. Good function with no loss in the salvage rate has been claimed, and if this is correct and confirmed the results in early cancers of the rectum would leave nothing to the desired. We shall have more to say about this procedure of Babcock a little later.

Until such time as some biochemical means is found that can influence the growth and dissemination of cancer cells, we must regrettably be forced to employ mutilating operations in our fight against this disease. Radiation has not been found to be effective in rectal cancer except in isolated and very selected instances. At one time when the operative technique was still in its infancy and radium had so recently entered the arena that its limitations had not yet been discovered there was a spirited controversy about the relative merits of surgery and radiation. As time went by there was a gradual thinning in the ranks of the champions of radiation until at the present time there is no one, so far as we are aware, left to hold the fort. In England, Sir Charles Gordon-Watson, the last of the adherents of radiation in rectal disease and one of the best known proctologists in that country, gave up his advocacy for it more than 10 years ago. We think that this fact should be more widely known in this country because there are still many patients referred to us for radium treatment of quite early and operable cancers of the rectum. At times it has been distressing to find all our efforts to persuade some of these to undergo a radical operation fail only because radium had been held out to them as the only hope by their medical advisers. It may be that it is felt that Indians do not

stand major operations of the magnitude of abdomino-perineal resections as well as patients in other countries. That this idea is entirely false is being proved in all hospitals in India where modern pre-operative and post-operative treatment is carefully carried out and the services of a well trained anaesthetist are available. Some of the patients subjected to radical resections of the rectum in our series would have been considered poor subjects for the average major operation.

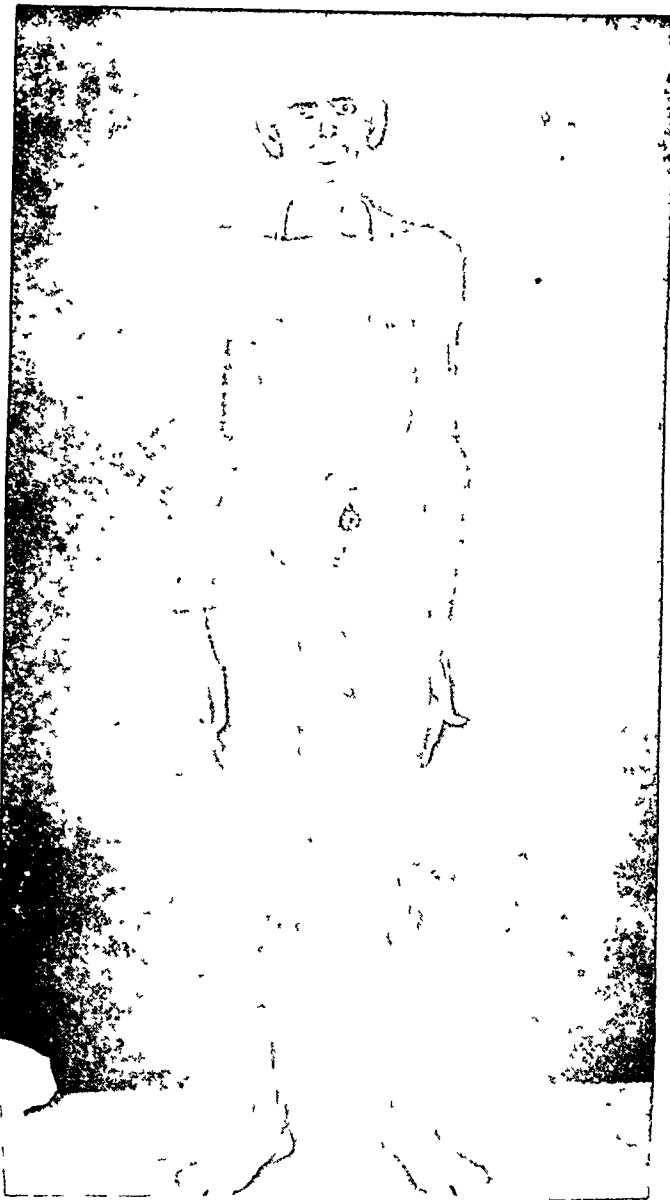


Fig. 1. Patient one month after a one-stage abdomino-perineal resection of the rectum. These patients of poor physique stand the operation surprisingly well.



Fig. 2.—Case No 4009. Squamous carcinoma of the anus—before treatment.

(Fig 1) One would therefore like to appeal to medical men in India not to hesitate to recommend such major operations to their patients when these procedures offer the only hope of cure.

#### RADIATION:

All this does not mean that there is no place for radiation in the treatment. Several cases were treated with X-Rays and radium when considered suitable. Advanced and inoperable cancers made up the bulk of these. The most satisfactory palliative results



Fig. 3.—Case No. 4609. Same patient as in fig. 2 after treatment and skin grafting.

were obtained with squamous cancer of the anal canal which possess a fair degree of radiosensitivity. To all outward appearances the growths had subsided and they remained quiescent for several months until eventual recurrence laid the patient low. (Fig 2 and 3) The adeno-carcinomas are more radio-resistant and show little response. Those who have used the million volt machine are enthusiastic about the palliation obtained.

It is possible to treat early cancers situated low in the rectum with the implantation of radon seeds as a curative measure. But

Binkley<sup>1</sup> of Memorial Hospital, New York, who has reported a few cures in this way, himself advises operation as offering greater assurance against recurrence. Radiation for cure should only be reserved for patients who are bad risks for operative surgery, and offered reluctantly to those who absolutely refuse operation.

All our radiated casts, 12 in number, have been treated for palliation. Six patients were treated with radium by the use of rectal applicators or insertion of radon seeds. Six other patients were treated with X-Rays by anterior and posterior ports or through a direct portal when the lesion was at the anus. Of the 12 radiated cases 5 were adeno-carcinomas of which only one showed a little improvement. We therefore now do not subject adeno-carcinomas to radiation. The other seven were squamous cancers and of these 5 improved considerably. All had recurrences in a few weeks or few months.

#### OPERATIVE TREATMENT:

Moynihan has very aptly said "Surgery of malignant disease is not the surgery of organs; it is the anatomy of lymphatic systems". Therefore a brief word about the lymphatics of the rectum will not be out of place. They may be divided into two groups; An inferior which drains the lymph from the anal canal into the inguinal nodes and a superior group which drains the rest of the rectum, taking 3 routes to ultimately reach the median aortic glands. These routes are (1) upwards with the superior hæmorrhoidal vessels, the main path for all practical purposes; (2) outwards along the superior surface of the levator ani to the obturator and internal iliac nodes; and (3) downwards through the ischiorectal fossa again to the internal iliac nodes.

Not all these anatomic pathways are always followed by cancer cells during the course of their spread. Studies have shown that of all the possible routes of spread open to cancer of the rectum proper the malignant cells almost invariably choose the shortest and narrow path upwards from the lesion if situated more than 3 cm above the anal canal line. In 102 specimens removed by Westheus<sup>2</sup> found that in only 12 cases of

there any involvement of a lymph node situated below the lowest limit of the lesion in the bowel. It appears that the lateral and downward routes, become highways of spread only when there is a block upwards, a condition that obtains in very advanced and inoperable cancers. Therefore in the early and operable case any operation that includes removal of this ascending lymphatic field in an adequate manner would seem to be radical enough. On this assumption are based the newer and less aggressive operations which aim at removal of the rectum with preservation of the sphincters.

### PALLIATIVE OPERATIONS:

Before taking up the question of radical surgery we should like to say a few words about palliative operations. Should a colostomy be done in a patient who is not obstructed is a question that has often faced us at an exploratory operation when an inoperable condition has been discovered. One is tempted to do it in order to save a second operation at a later date if obstruction should ultimately supervene, and perhaps because one feels that a colostomy might improve the general well being of the patient and prolong his life. After some experience of palliative colostomies we have become more inclined to the view that in the absence of genuine obstruction a colostomy should be withheld. Curses rather than grateful thanks have followed a colostomy unnecessarily performed. The patient does not tolerate it unless it has given him definite relief from painful constipation. As far as prolongation of life is concerned statistics have definitely shown no appreciable gain whatever. Therefore, now we do not advise a colostomy unless there is obstruction of a degree sufficient to distress the patient.

### RADICAL SURGERY:

No one radical operation can be used as a routine. The Surgeon must be prepared to use the procedure most suitable to the particular case; to fit the operation to the patient rather than the patient to the operation. Several operations have been devised and advocated. We shall not describe them all nor go into the history of their development. We shall only limit ourselves to the operations carried out at the T.M.H.

In the eradication of malignant disease surgery only the most radical measures can be expected to yield the best results. Therefore we believe that the Miles operation, abdomino-perineal resection or any other operation similar to it in scope and thoroughness should be adopted in all cases whenever possible. We prefer to use it even in cancer of the anal canal because even squamous cancers do metastasize along the superior hæmorrhoidal vessels when the mucosa is involved<sup>8</sup>.

We began cautiously in 1941 to use two stage abdomino-perineal operations but after 1943 we gradually began to attempt one-stage procedures because of the saving of time and hospital accommodation, and also because of certain drawbacks of two-stage operation that were brought home to us as time went by. With increasing experience we have come to believe that the one-stage operation of Ernest Miles is the most satisfactory operation, and does not carry any enhanced risk to the patient.

### NUMBER OF RADICAL OPERATIONS

Operations.	'41.	'42.	'43.	'44.	'45.	'46.
Two-stage ..	1	2	3	2	1	—
One-stage (Miles) —	—	—	1	—	1	—
Perineal Excision ..	2	2	2	—	1	—
Hartmann ..	—	—	—	—	1	—
Perineo-abdominal —	—	—	—	—	1	—
Babcock ..	—	—	—	—	—	1
	—	—	—	—	—	—
Total ..	3	4	6	2	5	10
	—	—	—	—	—	—

The objections to a two-stage operation we find are:—

(1) The patient has to undergo two operations and runs the risk that goes with any operation twice over.

(2) The prospect of two operations is less acceptable to the patient. It is easier to persuade him to agree to radical surgery when there is only one ordeal to go through.

(3) When the cancer is left behind for a second stage, any complication ensuing after the first stage may delay the radical operation indefinitely, and so permit the cancer to advance at the expense of curability.

(4) We have found that at the second stage, particularly in the Lahey operation, the

adhesions that have formed often increase the difficulties of the procedure and add to its gravity and duration. In a virginal field the operation is less time consuming, easier and productive of less shock.

We now use the two-stage procedure in only 3 types of patients:—

(1) In debilitated patients with obstruction who need some building up before being subjected to a formidable resection.

(2) Patients with marked obstruction that cannot be relieved by enemata and cautious purgation.

(3) In those cases which, on exploration exhibit extensive inflammatory adhesions which are difficult or dangerous to separate.

#### PRE-OPERATIVE TREATMENT:

The patient is admitted 4 or 5 days prior to the operation and a thorough evaluation of his ability to stand a major operation is carried out. This includes blood counts, and blood protein, non-protein-nitrogen, and sugar estimations, urine examination, cardiac efficiency tests etc. Any deficiencies are corrected. We do not believe in emptying the bowel by purgation; two enemata given on the day previous are sufficient to clear the bowel in the absence of obstruction. In the presence of a marked stricture daily enemata supplemented by very small doses of magnesium sulphate, just enough to render the stools soft are usually necessary. Occasionally in a rather debilitated individual a preliminary build up with liver extract, vitamins, and blood transfusions has been resorted to.

#### ANAESTHESIA:

A well trained anaesthetist is a great asset, and to him we leave the choice and administration of the anaesthetic. Both spinal and general anaesthesia have been used and though both are effective we have gradually come to rely more on general anaesthesia.

It is impossible to foretell the duration of the operation. Our operative time has ranged from 2 hours to 4 hours. It is all a matter of adhesions, size of the growth, capacity of the pelvis, the amount of abdominal fat and degree of perfection in team work. Spinal analgesia tends to wear off, and in an operation prolonged beyond the usual limits, has to be supplemented by another agent.

Complete muscular relaxation which greatly facilitates the operation and which is an especial feature of spinal analgesia can also be secured with inhalation anaesthesia administered by a competent anaesthetist. Recently with the help of curare it has been possible to obtain remarkable relaxation without exposing the patient to the dangers of prolonged deep anaesthesia. Since using curare we have not encountered any severe degree of post-operative shock.

#### OPERATIONS:

In our series of 113 cases, 51 were considered hopelessly advanced for treatment; 10 refused treatment; 12 were treated by radiation, 10 were explored and found inoperable. The remaining 30 were subjected to radical operations. Our operability rate therefore is distressingly low.

#### RADICAL OPERATIONS

Operations	Num- ber.	Mortal- ity.	Time of Death.	Cause of Death.
Miles	10	1	9 days	Uræmia
2-Stage Lahey	9	2	3 hours, 7 days	Shock, Periton- itis
Perineal				
Excision	8	—	—	—
Perineo- abdominal	1	—	—	—
Hartmann's	1	—	—	—
Babcock	1	—	—	—
	—	—	—	—
Total	30	3	—	—
	—	—	—	—

#### PALLIATIVE OPERATIONS

Palliative Excisions 4, Died 1 (Urinary Sepsis)  
Colostomy Only 10, Died 2

It will be noticed that the one patient we lost after a Miles operation did not die from shock but from uræmia 9 days later. This supports our impression that the one stage abdomino-perineal operation is not more likely to be attended by shock than the two stage procedures.

It will also be noticed that of the two patients who succumbed after a two-stage Lahey operation one died from shock and one from peritonitis. This again tends to suggest that splitting an operation into two-stages does not necessarily eliminate shock or infection.

## RESULTS

## A: Alive without Recurrence

5 Years	..	..	1
4 "	..	..	1
3 "	..	..	2
1 To 2 Years	..	..	5
Less than 1 Year	..	..	8
TOTAL			17

## B: Dead

12

One recurred after 3 years.

One died from complications of leprosy 2 years later.

## C: Not Traced—1 done 3 years ago.

## ONE-STAGE ABDOMINO-PERINEAL RESECTION:

As mentioned earlier we have come to adopt the Miles technique in most of our cases. A detailed description of this operation would take up too much time and so we shall only touch upon certain features of the operation which we consider important.

It is absolutely essential to have the bladder empty so that every possible space and utmost exposure is available deep in the pelvis. A self retaining catheter attached to an Aspto syringe provides the continuous suction necessary to secure this end.

We prefer a left lower paramedian incision unlike Miles who uses one on the right. It is easier to handle adhesions in the left paracolic region in this way and it also enables us to place the terminal colostomy in the same wound. (Fig. 4)

A rather high Trendelenburg position is of great help in clearing the pelvis of all impeding coils of gut.

In tumours situated low in the rectum it is wise to make a nick in the pouch of Douglas to introduce a finger and palpate the growth for operability. A tumour that is fixed to the lateral walls of the pelvis is definitely inoperable. Fixity posteriorly or anteriorly need not deter an attempt at removal unless very marked. Having decided on resection, we find it convenient first to determine at what point in the sigmoid a colostomy would be ideally situated. The loop that goes to form the colostomy should not be too short in which case it may be pulled in subsequently when the newly constructed pelvic floor sags down; or too long when there is always a chance of prolapse. Leaving about an inch of bowel protruding above the skin level in making a colostomy ensures against possible peritonitis in case necrosis of the terminal segment follows from interference with the vascular supply by a pull on the mesentery exerted by the descending floor or by overdistension of the colon.

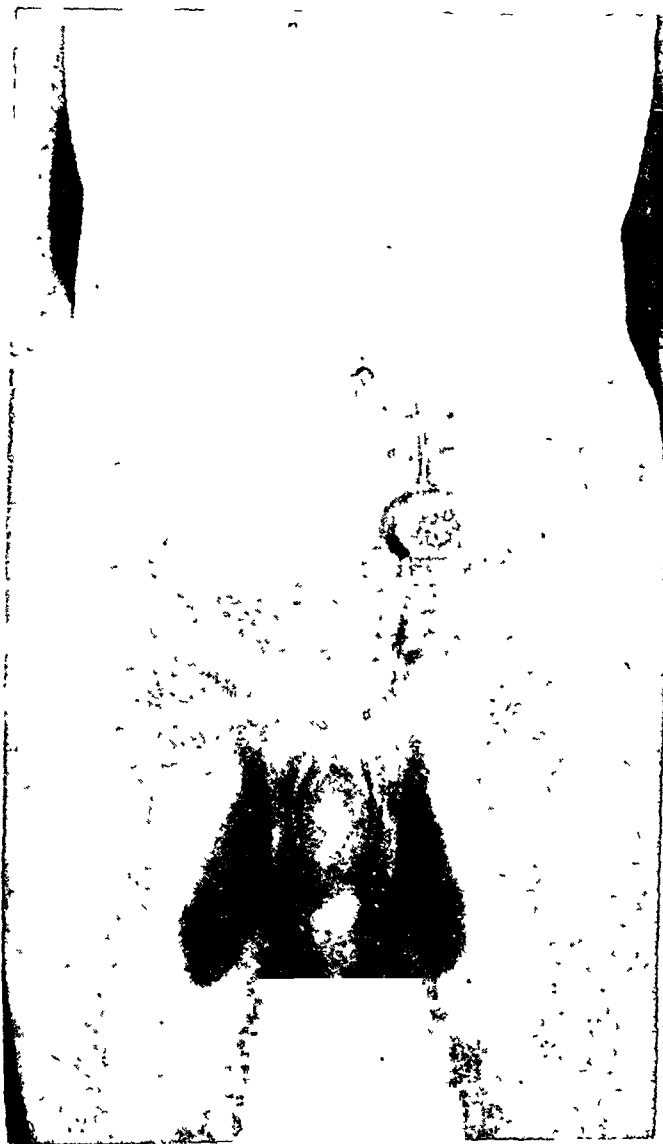


Fig. 4.—Well healed abdominal wound with terminal colostomy after a one-stage abdomino-perineal resection of the rectum.

From this selected point on the sigmoid the peritoneum of the mesentery is slit open on both sides from before backwards to expose the superior hæmorrhoidal vessels a little above the sacral promontory. Careful location of the left ureter at this stage prevents it from being included in the ligature around the vascular bundle. When the operability is still in doubt it is wiser to defer tying the main vessels until the growth has been isolated. If the attempt at separation proves abortive not much harm has been done if the vascular supply of the rectum is still intact. There is no doubt, however, that preliminary ligature does reduce materially the bleeding encountered later in the operation.

Manual dissection of the rectum should be carried right down until the coccyx is felt posteriorly and the prostate anteriorly. When these limits are reached from above and the lateral ligaments on either side are completely severed the perineal stage presents no difficulties whatever.

In severing the bowel we use an ordinary long hæmostat on the proximal side, crush the bowel distal to this with a Peyer Clamp, remove the latter and tie a tape below the crushed area. The gut is then cut through the crushed segment. The distal stump is covered by a rubber condom secured by a tie. The proximal segment held in the hæmostat is covered with gauze and held out of the way.

The pelvic peritoneum must be mobilised to reconstruct the floor and usually much of this membrane has to come from that covering the bladder. The rectum is pushed into the pelvic hollow and the peritoneal diaphragm constructed above it. No hole should be left in this to tempt a wayward coil of small intestine. If the bowel is too bulky to fit under this new pelvic floor it may be necessary to resect a portion of it. This must be done with the most aseptic precautions otherwise contamination may lead to complications. The only case we had of peritonitis arose in this way.

Before closing the abdomen it is well to see that the descending colon and sigmoid are well mobilised to avoid kinking when the peritoneal floor descends. Inattention to this

resulted in annoying obstructive symptoms in one of our cases. The terminal ileum too may be kinked and needs a final look up.

The terminal colostomy is made by implanting the gut held in the clamp at a spot in the incision convenient for subsequent management—At least one inch of the bowel should protrude. (Fig. 4).

For the perineal phase of the operation we formerly used the lithotomy position but

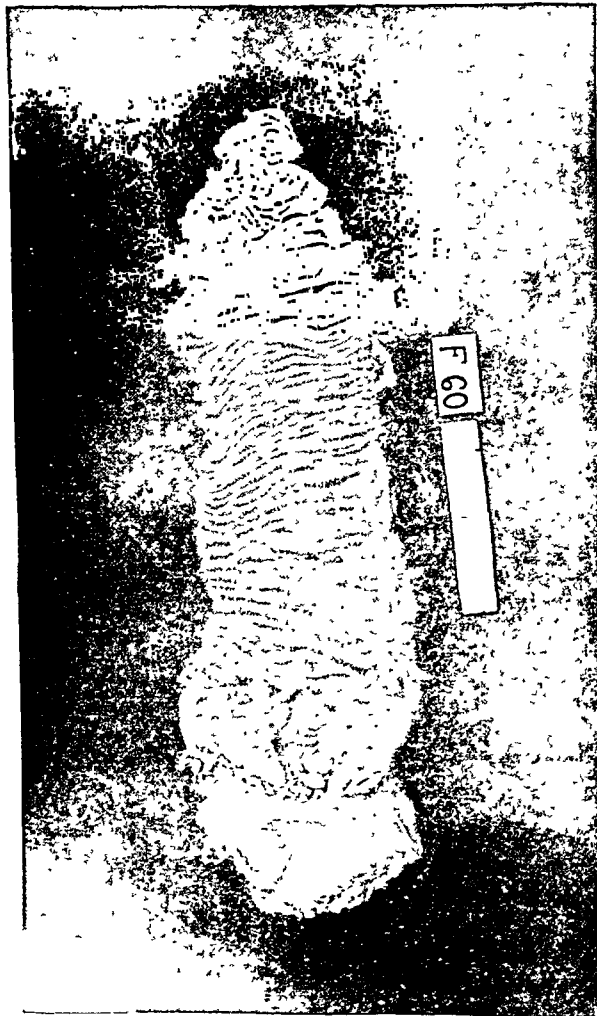


Fig. 5.—Photograph of specimen of squamous carcinoma of anal canal involving also rectal mucosa resected by a one-stage abdomino-perineal operation. Length of specimen 30 c.m.



we have now given it up in favour of the lateral position. The lithotomy posture is very trying to the surgeon's assistants, besides affording less exposure and view of the pelvic walls from a sagging backwards of the bladder and peritoneum. The lateral position is entirely free from these defects.

If the abdominal dissection has been well done the perineal part usually does not take over 20 minutes. The extent of the skin and perineal tissues removed depends upon the location of the lesion, a wider excision being called for in lesions situated low in the rectum.

The prostate and vagina may have to be sliced off if involved in the cancerous process.

Careful hæmostasis is important, particularly as latterly we have learnt that omitting the traditional large pack in the pelvic space results in very early wound healing. We now use a small pack adjacent to the prostate and seminal vesicles or vagina where there are many thin walled veins that ooze freely. In the absence of a large pack intra-abdominal pressure obliterates the pelvic raw space in 2 or 3 days.

During the operation the patient receives a slow continuous drip of 5% glucose in water and we anticipate serious blood loss that sometimes occurs during the perineal phase by a timely blood transfusion given at the beginning of this stage.

#### POST-OPERATIVE TREATMENT :

Some patients suffer from shock at the end of the operation and need the help of oxygen and infusions to rally them round, though better attention to hæmostasis and the use of curare have considerably reduced the need for this. Nothing is given by mouth until the terminal colostomy clamp is released at the end of 48 hours. What gives most trouble is the bladder. The time taken for the patient to pass urine of his own accord has varied in our cases from 24 hours to 10 days. Formerly we used to harness an elaborate tidal drainage apparatus to the job of emptying the bladder at regular intervals; but as the least relaxation of attention to details of keeping the instrument clean is likely to invite the very trouble it was created to avoid we have now discarded it. A catheter tied in for the first 48 hours and

subsequently the judicious use of Moryl and aseptic catheterisation when necessary has solved our problem.

The perineal pack is removed partly after 24 hours and completely after 48 hours and gentle irrigations started on that day. Colostomy washouts are begun on the 5th day. In our recent cases where a minimal pack was used the perineal wound has healed by the 18th day and the patient discharged at about that time. In our former cases the perineal wound took from 6 weeks to 2 months to close up.

#### COMPLICATIONS :

These refer to all types of Radical operations undertaken—30 in number:—

1. Shock: Some difficult cases have shown an alarming fall of blood pressure on the evening of the operation. This secondary shock proved fatal in one case.
2. Urinary sepsis—9 cases, usually responded to mandelic acid.
3. Peritonitis—one case mentioned above.
4. Uræmia—one case died on the 9th day.
5. Pulmonary complications—one case of severe bronchitis in a chesty individual.
6. Coronary Thrombosis—one case that recovered.
7. Retraction of colostomy—two cases—no serious trouble.
8. Thrombophlebitis—one case.
9. Urinary fistula from injury to ureter—one case.
10. Abdominal wound infection—3 cases.

We shall now briefly discuss the other radical operations done by us.

**THE TWO STAGE LAHEY OPERATION**  
used to be our favourite procedure in the past, but for reasons already given we now use it only when the three indications mentioned exist. The first stage consists in dividing the sigmoid and its mesentery at a suitable point and bringing the proximal end as a permanent terminal colostomy in the paramedian region, and transplanting the distal end in the mid-line above the pubis. The omentum is stitched to the edges of the V-gap in the mesentery so as to exclude the

pelvis from the general abdominal cavity. At the second stage through a mid-line incision the implanted gut is dissected away from the abdominal wall and the rectum resected as in the usual abdomino-perineal operation.

**PERINEAL EXCISION** we have carried out in certain of our earlier cases of cancers situated low in the rectum when we did not have enough experience. But the only indications for this operation are when the general condition of the patient is not suitable for more radical measures, and as a palliative treatment to relieve distressing rectal symptoms in advanced cases. A preliminary laparotomy to establish operability and loop colostomy are necessary. The objections to this operation are that it is not sufficiently radical leaving, as it does, a large part of the upper lymphatic field untouched, and it often results in a persistent mucous fistula in the perineum due to leakage from the sutured stump of bowel.

#### **PERINEO-ABDOMINAL RESECTION :**

So strongly championed by Gabriel has been attempted only once. It does not attract us, being more involved than the Miles operation though equal to it in its radical nature. The abdomen has to be first opened to confirm operability. It is then temporarily closed while the perineal stage is undertaken, and again reopened to complete the resection. This entails an unnecessary waste of time and changes in the position of the patient.

#### **HARTMANN'S OPERATION:**

Hartmann's Operation was forced upon us in one case. After tying the vascular pedicle in a regular Miles operation and partially separating the rectum the patient's general condition suddenly deteriorated and the operation had to be completed hurriedly. The perineal phase of the operation was out of the question, and therefore all that could be done was to excise the sigmoid and upper rectum with the tumour, invert the lower stump, place it under a reconstructed peritoneal floor and complete the terminal colostomy in the ordinary way. The patient did well and so far is quite well 1 year and 8 months later. This operation is by no means radical, but it is certainly permissible under such extenuating circumstances.

#### **ANTERIOR RESECTION :**

Anterior Resection and end-to-end anastomosis is an operation which is again being advocated by surgeons like Grey Turner in England and Claude Dixon of the Mayo Clinic in America. We have never had occasion to try it but we feel that the procedure is not radical enough for cancer, and though one may occasionally get away with a cure we are sure that more often than not one would regret having performed it.

This operation of course can only be carried out when the lesion is situated well above the peritoneal reflection and when so situated, there can be no question, that anterior resection would certainly be the procedure of choice in two types of cases:— (1) in certain poor risk patients and (2) when a patient has his mind definitely set against a colostomy.

#### **BABCOCK'S OPERATION :**

Babcock's Operation of abdomino-perineal resection with preservation of the sphincters has long intrigued us by the attractive prospect it offers the patient of a perineal colostomy with apparently no loss in the salvage rate. We have had only one experience of this in a young woman professor at an Indian University who was very insistent on avoiding an abdominal anus, if it could possibly be helped. She had an adeno-carcinoma 3 inches above the anal margin. In this operation the usual abdominal dissection is done with the exception that the ligature is placed on the vessels at a point that maintains the blood supply of a considerable portion of the sigmoid colon which has to be brought out of the perineal wound. Herein lies the chief objection to the operation as in his anxiety to preserve the vascular supply the surgeon is apt to be less radical in his removal of the lymphatics in the sigmoid mesentery.

In the perineal phase the operation differs materially from the abdomino-perineal resection in that a circular incision at the ano-rectal junction is used to preserve the sphincter, and the bowel to be resected is drawn through the sphincter which is split posteriorly upto the coccyx to facilitate the procedure. The rectum is then severed outside the anus leaving about an inch of

viable gut protruding. As the sphincters and the levators are preserved it is obvious that this operation can only be justified when the lesion is situated more than 2 inches above the anal canal.

So much has been written about Babcock's operation that it would be well to discuss it here. This attractive operation can only be judged by its results. Babcock and his colleague Harry Bacon are very enthusiastic about them. In a recent publication Bacon<sup>9</sup> has reported 461 cases with a 5-year cure rate that rivals the more established operations. But these results have yet to be confirmed. To us it seems that any concession made to functional convenience at the expense of complete eradication must be paid for by an added risk of recurrence. In the surgical treatment of cancer the first principle above all is radical and complete removal; everything else is secondary. Nevertheless there is today a tendency to be more conservative in the operations for rectal cancer. But as far as we are concerned we feel that it is wiser to keep to the older and well tried methods until the newer con-

servative resections have been given a fuller trial and have stood the test of time.

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# EXCISION OF THE RECTUM WITH RESTORATION OF CONTINUITY

By

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Excision of the rectum is indicated especially in two conditions, viz.:—malignancy and non-malignant strictures, like certain cases of polyposis, and ulcers which are of doubtful nature. Among non-malignant lesions which give rise to rectal stricture, lymphogranuloma-inguinale is the most common, and excision of the rectum and anal canal is found to give very good results.

In the case of carcinoma also early excision has been found to give very gratifying results, because the lesion remains localised for a longer time than malignant lesions in other places. The investigations of Davis and Collier have shown that if a carcinoma of the rectum or sigmoid has not metastasized beyond the para-rectal lymph nodes, the extension may just as well be in the liver or some remote regions as in the next lymph node, viz. the intermediate or central groups. So if there are no metastases beyond the paracolic lymph nodes, adequate excision of the colon including the primary lesion together with the epicolic and paracolic lymph glands offers almost as good a prognosis for cure as does a wider resection including the intermediate and central lymph nodes.

In the majority of cases excision of the rectum is done after performing a preliminary colostomy which is allowed to remain permanently. There are cases where patients with carcinoma of the rectum have refused a radical operation for fear of having a permanent colostomy. So wherever feasible if an excision of the rectum is done without colostomy and good prospects of return of function is guaranteed, it would place both the surgeon and patient in a happier frame of mind.

Below are given two methods by which excision of the rectum was done without a colostomy and the continuity of the rectum and anal canal was maintained. In females

the excision was done by the vaginal route and in males by the sacral route. These methods are applicable to cases in which the carcinomas are not fixed to the surrounding structures, have not produced complete obstruction, and which are either a cauliflower or an ulcerative type of lesion. The growth should be easily palpable through the rectum, and for a trans-sacral resection the upper margin of the growth must be palpable with the finger in the rectum and be freely movable on the surrounding structures. If the growth is in the anal canal it must be freely movable on the sphincter muscle.

## (1) Excision of the Rectum by the Vaginal route.

This method is ideal when the growth is in the lower rectum or ampulla, and the upper end of the rectum, provided it is not too far advanced.

*Technique of the operation:* The anal sphincter is thoroughly dilated and rectum is packed with gauze and the anus is closed with sutures. The technique followed is the one described by L. Burch. A semicircular incision is made behind the cervix, the peritoneum opened and a suture passed through it, for future identification. The pelvis is explored by inspection and palpation and gauze packs placed above the brim, to keep the small intestines from getting into the operation field. An incision is then made from the centre of the semicircular incision down to within half an inch of the anus. This incision is carried down to the rectum with care not to button-hole it. (Adapted from Grant.)

The superior hæmorrhoidal artery is ligated and divided between double ligatures and the gut divided with cautery between clamps. With the main source of blood-supply ligated and the peritoneum opened it is quite easy

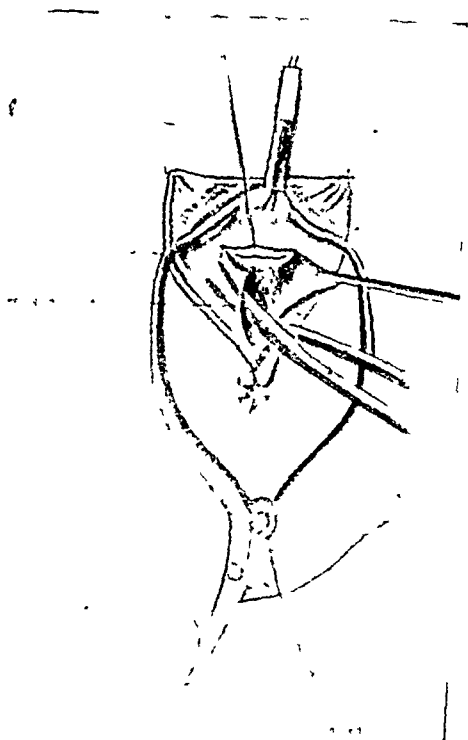


Fig. 1. Excision of Rectum through the Vagina. (L. Burch).

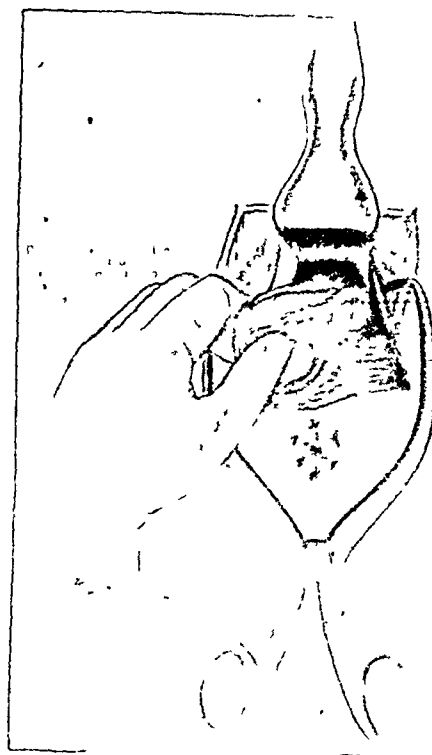


Fig. 2. Excision of Rectum through the Vagina. (L. Burch).

to detach the upper end of the rectum from the sacrum with the finger working in one direction and then in another. The mesorectal and lateral ligaments are incised and the rectum separated from the vagina by dissection with scissors. Oozing is controlled by gauze packs, middle hæmorrhoidal vessels ligated and the gut freed from levator ani muscle, down to the anus. The rectum and anal canal are ligated to prevent leakage, and incised with cautery and the whole rectum which is now detached is lifted out through the vaginal incision. The mucous membrane of the anal canal after being cleansed with picric acid is dissected out and removed. The clamp on the lower end of the sigmoid is then removed, a corrugated tube placed in its lumen, and held there by a silk ligature. It is then brought down, passed down through the anus and sutured to the anal margin with interrupted sutures. A drainage tube is placed in the peritoneal cavity and the peritoneum is closed by suturing it to the gut. At the lower end of the wound several interrupted sutures of cat gut are carried

through the Levator Ani of one side the walls of the gut being grasped first and then the Levator Ani of the opposite side and tied. Both the drainage tubes are brought out through stab wounds.

Three cases are quoted below in which this method was followed in excising the rectum. In two of these, the patients were suffering from carcinoma and the third case was one of lymphogranuloma inguinale affecting the rectum and the anal canal.

#### CASE 1:

Mrs. L. N. N. Age 44. The patient was admitted in August 1934, for bleeding per rectum with prolapse (of about eight years' duration). On examination a tumour of the size of a small orange, soft with an irregular nodular surface and bleeding easily, was found situated about  $2\frac{1}{4}$  inches from the anal opening. From the appearance it looked like a polypus undergoing malignant degeneration. Operation was done on 23rd August 1934, under spinal stovaine. The

vaginal walls were retracted, a transverse incision was made in the posterior fornix, and the peritoneal cavity opened. From this a vertical incision was made upto within half an inch of the anal opening. The vaginal walls were separated from the rectum and the rectum completely isolated on all sides after separating the Levator Ani muscles. The other steps were exactly the same as described above. The patient was kept constipated till 29-8-34. The next day a purgative was given with good results. On 31-8-34, a small recto-vaginal fistula was detected discharging a little faecal matter which gradually healed after about six weeks. The patient was discharged on 18-9-34, feeling very much better. Pathological examination of the tumour showed adenocarcinoma. When seen in 1938, she was found to be keeping good health and free from all symptoms.

#### CASE 2:

Mrs. D. Age 40. Admitted in June 1937 for an advanced carcinomatous tumour involving the rectum and anal canal and posterior vaginal wall extensively and giving rise to a recto-vaginal fistula. The operation was done on 26th January 1937. A circular incision was made from the posterior fornix of the vagina round the growth encircling the rectum and anal canal and including the affected portion of the posterior vaginal wall. The peritoneum was opened in the pouch of Douglas and the rectum and anal canal along with the affected portion of the posterior vaginal wall was completely isolated all the bleeding points being caught and ligated. The rectum was divided about one and a half inches above the growth and removed along with the anal canal, and the remaining portion of the rectum was brought down and stitched to the anal opening. The pouch of Douglas was closed, but the gap in the posterior vaginal wall was left open and the cavity packed with gauze. But the patient's condition grew worse and she expired about four hours after the operation. This was an advanced case and not fit for any operation.

#### CASE 3:

Mrs. G. H. Age 30. Admitted in June 1937 for difficulty in defaecation for the last

six months. About seven months back she started passing blood and mucus per rectum and then gradually developed difficulty in passing stools. On examining a hard mass detected about one and a half inches above the anal opening with obstruction of the lumen through which a probe could be passed with difficulty. It was a definite case of lymphogranuloma inguinale. The whole of the lower rectum and anal canal were removed and the bowel was brought down and stitched to the anal opening, according to the method given above. The wound healed nicely without any complication and the patient was discharged in very good condition on the 17th day of the operation.

#### (II) Excision of the Rectum by the trans-sacral route.

The method followed is a modification of the original Kraske's method. An incision

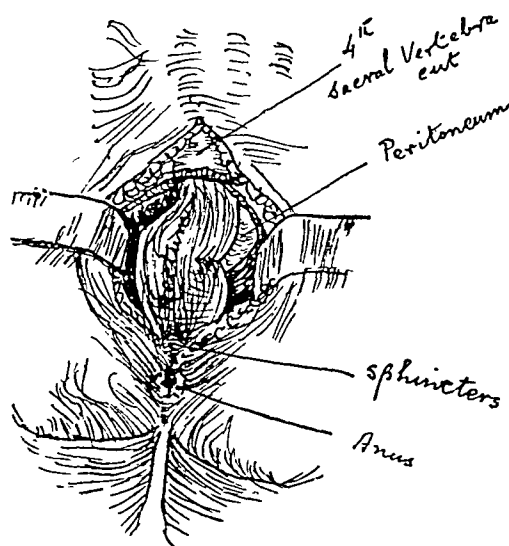


Fig. 3. Trans-sacral method of operation for Excision Rectum with restoration of continuity.

is made from the third spine of the sacrum down to within half an inch of the posterior anal margin. The coccyx, the fifth and half of the fourth sacral bodies are removed. The pelvic fascia is divided. A sound is introduced in the urethra to protect it when separating the rectum from it. The dissection is car-

ried around the circumference of the rectum outside the perirectal fascia. A tape is placed around the rectum and by gentle traction and digital dissection, the upper portion of the rectum and sigmoid are drawn down. The peritoneum is opened on the anterior surface and sufficient sigmoid is drawn down which would allow the healthy rectum to be brought down to the anal opening. When this has been accomplished the peritoneum is reattached by sutures to the anterior wall of the sigmoid at a new level higher up. The further process is exactly like the one given above as described by L. Burch.

### CASE REPORT

#### CASE (I):

Pt. G. M. Male aged 35. Admitted in the K.E.M. Hospital on 3-11-42, for bleeding during defæcation for the last two years. For the last one month the pain and bleeding have increased. On examination a large polypoid growth, sessile, the size of a small orange, was detected in the anal canal 1" above the anal opening, extending to about 2" above. Some tow was inserted in the rectum and the anal opening was closed by silk purse-string suture. An incision 6" long was made 1" from the anal opening to the third piece of the sacrum. The coccyx was removed and also two pieces of the sacrum. A sound was introduced into the bladder to identify the urethra. The rectum and anal canal were gradually separated from the surrounding structures and bleeding points were ligated. As the rectum was not fully distended with tow, it could not be fully identified, and in separating it with the finger a small tear

occurred in its wall which was closed with catgut. The peritoneal pouch was not opened as the separated gut looked sufficient to be brought to the anal opening. In separating the gut from the upper reaches of the sacral fossa, a good deal of mucoid secretion was found to exude. A circular incision was made round the anal opening and the anal canal separated from the surrounding anal sphincter, and the Levator Ani muscles divided. The gut was divided about two inches above the growth and the remaining portion was brought down and stitched to the anal opening by four retention stitches of chromic catgut reinforced by continuous stitches. The posterior wound was closed with a drainage tube. This was removed after two days. The wound healed nicely. The growth was found to be adeno-carcinoma undergoing mucoid degeneration. The patient was progressing very well, control being well maintained in defæcation as the external sphincter muscle was functioning satisfactorily. On the fifteenth day of the operation the patient developed hemiplegia with aphasia. But the condition improved gradually and the patient was completely free from hemiplegic condition after seven days. The patient was discharged in good condition with the anal canal functioning normally. The hemiplegia must have been due to a transitory embolic condition as the patient was very much debilitated before the operation.

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# A HUNDRED YEARS' HISTORY—1843 TO 1943—OF STRANGULATED INGUINAL HERNIA

By

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In the year 1844 Mr. Banner<sup>1</sup> reported a case of strangulated hernia. The patient had vomited twice, but this was attributed to taking medicine by mouth. In this case merely because the patient did not vomit frequently enough, the operation was delayed—and the patient died.

In the year 1846 Malgaigne<sup>2</sup> recommended the following technique for reducing a strangulated hernia: "(1) evacuate the bladder, (2) ask the patient to breathe freely, (3) at the commencement make slight pressure, (4) return first the parts that last protruded, (5) return them in the same direction they came out in." In the year 1849 Dr. Neuhold<sup>3</sup> recommended enemata of acetate of lead—gr. 10 to 6 ozs. of water—as a treatment for reducing strangulated hernia. He said "the patient goes to sleep and the strangulated hernia reduces by itself or easily by taxis." In the year 1855 M. Sentin<sup>4</sup> of Brussels recommended continuous gradual taxis, and when this failed "he endeavoured to hook his finger round the margin of the ring by passing it between the tumour and the abdomen, and by using a certain amount of force he caused the fibres of the ring to give way and crack to an extent sufficient for the reduction of the hernia." In 1859 Dr. Lafourge<sup>5</sup> succeeded in reducing a strangulated hernia by placing the patient almost vertically head down and kneading the abdomen, and considered this manipulation more rational than taxis." The head down position was considered to be so efficacious that some surgeons<sup>6</sup> used a well-padded board 6' x 15". The patient was placed on this board and the knee of the sound side was flexed over one end and secured. The foot of the board was then raised, if necessary almost to a perpendicular

and the hernia manipulated. It was said to be invariably successful. Other surgeons recommended pouring cold water<sup>7</sup> or ether<sup>8</sup> on the hernial swelling before attempting reduction. The rationale of the method was that cold helps to diminish the contents of the sac, and in addition has the stimulating effect of causing movement of the muscular coat of the intestine and thereby promote reduction. Do we not see the very same principles in our present day methods of reducing a strangulated hernia—an ice bag on the inguino-scrotal swelling, raising the foot of the bed, an injection of atropine sometimes combined with morphia and gentle manipulation?

In the year 1872 M. Leon Abbe<sup>9</sup> reported a case of strangulated hernia which he could reduce after letting out gas and about 2½ ozs. of yellowish liquid by means of a No. 2 needle. In connection with this method it is interesting to recall what Dr. Dieulafoy<sup>10</sup> said at the Societe de Chirurgie. He definitely stated: "(1) In not one instance out of 24 cases of all types of herniæ had there occurred the slightest accident, (2) Aspiration being the most direct and efficacious auxiliary of taxis, the rational treatment of strangulated herniæ, with some rare exceptions, begins with puncture. Aspiration had afforded 16 cases of cure out of 24 cases which resisted taxis, (3) The *modus operandi* was of the simplest: the needle is introduced through the skin and aspirates all the liquid and gaseous material, those of the intestine as well as the sac. The tumour collapses and the reduction is most easily accomplished. When the hernia is not reduced, it shows that there exist adhesions, then it being needless to prolong taxis, and celotomy must be done."



Referring to taxis we would now shudder at the very idea of such forcible taxis as was recommended in those days. M. Gosselin<sup>11</sup> says: "begin pressure gently, but gradually use force, lean the whole body on the patient, and even call an assistant to help—four hands being then forcibly applied to the tumour." I might also mention here what was known as coughing taxis—described by G. Wherry<sup>12</sup>. "That cough which so often produces hernial protrusion may be used with the greatest advantage during reduction. During manipulation the patient continues to cough, only stopping for rest or retch—alternating contractions and relaxations of the ring being most favourable for the return of the hernia."

While a group of surgeons thus tried non-operative methods of treating cases of strangulated hernia, with often fatal results, another group of surgeons applied themselves to developing operative procedures. In a case of strangulation however, the rule was to try as far as possible, as we have just seen, reduction by manipulation. However when an operation did become inevitable, it was done according to the tenets of surgery then accepted. But the results of operation even were not at all encouraging. In a statistics<sup>13</sup> on strangulated hernia published in the year 1843, operative mortality at Paris was 4 out of 7 and at Wurtzburg 3 out of 7. Another statistics published in the year 1844<sup>14</sup> is as follows:—

Surgeon.	No. of cases.	Deaths.	Mortality (about)
Sir Astley Cooper	77	36	50%
Scarpa	16	5	32%
Hey	12	6	50%
Wurtzburg	56	24	45%
Dewar of Dunfermline	17	4	25%

While Mr. N. Ward<sup>15</sup> gives the following figures: in 100 cases of strangulated hernia, 33 were of the inguinal type with 11 deaths i.e. death ratio of 1 to 3.

In the year 1854 Mr. Ure<sup>16</sup> published a case of strangulated hernia. In this case the sac

did not contain any fluid but only omentum and small intestine. The sac was not excised. The intestines were returned into the abdominal cavity and as part of the omentum was adherent to the sac, it was left in situ. The sac was not tied. The wound was sutured. During convalescence the patient passed a large quantity of blood in his stools. The patient afterwards wore a truss. Whenever it was decided to operate on a case of strangulated hernia, the operation was carried out according to the precepts of one of the two schools of procedure. One school believed that during the operation the sac of the hernia should never be opened, and the adherents of this school of thought contended that deaths in cases of strangulated hernia which were operated, were perhaps due to the opening of the sac—"since in this procedure the intestines were being handled." The same conception was held as early as 1849 when Mr. Luke<sup>17</sup> stated during a discussion on strangulated hernia "that the majority of surgeons were inclined to favour the method of not opening the sac." It was perhaps for this very reason that Prof. Pancoast<sup>18</sup> advocated the method of subcutaneous division of the constriction. The operation was originally devised by Mr. Guerin. In the year 1861 Mr. Thomas Bryant<sup>19</sup> reported a case of strangulated hernia, in which the favourable result of the operation was attributed to the fact that "the sac in that case was not opened sufficiently wide enough to expose any portion of the intestine, nor to allow the surface of the strangulated bowel to be manipulated." In the year 1857 Mr. S. Solly<sup>20</sup> in his clinical lecture remarked that "if there is one point in surgical practice the propriety of which I am more thoroughly convinced than another, it is that of not opening the sac as a rule. Where you are able to perform the operation without exposing the gut, I am sure you increase the chances of a favourable result by at least tenfold." In 1855 Mr. Ward<sup>21</sup> summarised a discussion on this point. During this discussion Mr. Hewitt stated "that the rule at St. Georges Hospital was the reverse of that adopted at the London Hospital—being in fact to open the

sac freely." He considered that "if the cases of strangulated hernia were seen at a much earlier period than they commonly are at our hospitals, and if protracted efforts at reduction were more generally given up, the rule of not opening the sac would find many more advocates than at present." Even at such early times, therefore, it was recognised by at least those surgeons who thought over the problem, that protracted efforts at reduction do positive harm to the local lesion, and that in such cases it is necessary to open the sac and ascertain the condition of the contents. In connection with this discussion whether the sac should be opened, the following case published in the year 1857 is of interest. "A man aged 36 years was operated for strangulated hernia of three hours' duration. It was reduced without opening the sac. A few hours later the bowels were suddenly relieved with passage of blood and fæces. Severe pain set in over the abdomen for which leeches were applied, and in  $\frac{1}{2}$  an hour or so the patient died<sup>22</sup>." In another case the patient died 2 days after the operation. May it not be that if the sac had been opened, the findings would probably have lead the surgeon to adopt a different procedure than to return the contents, as they were, to the abdomen? As early as the year 1869 Mr. H. Lee<sup>23</sup> insisted that the sac of a strangulated hernia should be opened for several reasons: (1) that the condition of the bowel in that way be ascertained, (2) that the fluid contents of the sac if not opened are returned into the abdomen which consist of blood, lymph and serum in which various alterations are taking place. This decomposing fluid may be the cause of peritonitis. The advantages of opening the sac are clearly demonstrated by the following case history: In a case of strangulated hernia the loop of intestine was merely congested, but a piece of omentum which was gangrenous was excised<sup>24</sup>."

About the year 1855 a discussion took place on the value of purgatives in cases of strangulated hernia. It was stated that<sup>25</sup> "when the condition of the patient is good and there is little or no peritonitis, an

oleagumous enema should be given an hour or two after the operation and repeated after three or four hours in cases of failure, or a mild purgative exhibited by the mouth. When the peritoneal inflammation is intense, even the bowels be in a poor condition, antiphlogistics must be perseveringly employed, and though a simple enema may be given in the first six hours and be advantageously repeated, it is inadvisable to excite the action of the bowels until the next day either by more active enemata or purgatives by the mouth. In the case of mortification threatening the gut, the bowel should be kept quiet by opium, and purgatives as well as enemata should be jealously abstained from, until the danger of perforation has passed." In this connection Mr. S. Solly<sup>26</sup> remarked in the following stern language: "In almost all cases of strangulated hernia which come to London Hospital, purgatives have previously been given *ad libitum*. In truth so changed are the guts with these powerfully persuasive medicines that after the mechanical obstruction to the fæculent discharge has been removed by an operation, down come the saline secretions like a torrent and your patient is positively washed into his grave by a supercathartic diarrhoea."

About the year 1859 Mr. T. Tatum<sup>27</sup> described a case of strangulated hernia which was operated and the patient survived in spite of severe vomiting, constant hiccough and great tympanitis. The sac was found to contain intestine "ten inches long of a deep red colour with ecchymosed patches on the surface." This case appears to be the first attempt at recorded description of operative findings, of the intestinal contents of the sac.

In the year 1871 a great step forward was taken in the technique of operation for strangulated hernia. In that year Mr. Hulke<sup>28</sup> operated on a case of strangulated hernia. He had to open the sac to reduce the contents. "The wound was dressed according to Prof. Lister's plan. The dressings were removed on the 5th day and the patient discharged on the 15th day. The wound healed remarkably quickly."

In the year 1885 Mitchell Banks<sup>29</sup> described in detail a case of strangulated hernia in which a portion of the gut was gangrenous. He described his procedure of resecting the dead loop and doing a primary end-to-end anastomosis. His patient lived. Other contemporary surgeons recommend incising the gangrenous gut portion and establishing an artificial anus. We now know that the treatment of gangrenous gut is a very vexed question. The procedure depends entirely on the surgeon and the condition of the patient—some make an artificial anus, while others believe in doing a primary anastomosis.

As late as the year 1896 Mr. Shelwall Thomas<sup>30</sup> of Liverpool Medical Institute specially urged thoroughly carbolising the contents of the sac before attempting reduction. I suppose this was recommended because of the fear that probably handling of the loops of intestine would cause peritonitis after reduction—the same reason for which 50 years previously it used to be recommended not to open the sac.

The present day operation for strangulated hernia is as follows:—

1. Pre-operative preparation of the patient i.e. local cleaning of the part including shaving, administration of an enema, application of an antiseptic locally on the operation table and isolation of the part for operation by sterile towels.
2. Administration of a suitable anæsthetic.
3. An oblique incision down to the sac.
4. Opening of the sac, cutting of the constriction, incising the Ext. Oblique Aponeurosis and examination of the contents of the sac.
5. Appropriate treatment of the contents of the sac.
6. Dissection and ligature of the sac.
7. Suturing of the Ext. Oblique Aponeurosis, with catgut.
8. Suturing of the skin with an unabsorbable material—usually without drainage.

\*\*A part of this paper was read before the Staff Meeting of the Sir J. J. Hospital and Grant Medical College, Bombay.

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# AN EXPERIMENTAL STUDY OF THE ETIOLOGICAL FACTORS IN URINARY LITHIASIS.

By .

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## EXPERIMENTAL

In an attempt to work out the etiology of Urinary Calculi a number of animal experiments have been made by the author, some of them being confirmations of previous work on similar lines. The main work has been done on rabbits where the effects of presupposed etiological factors have been noticed and studied both macroscopically and microscopically on the upper and lower urinary tracts. The next series of experiments, still in progress are those on white rats where an attempt has been made to confirm the vitamin deficiency and dietetic factor effects on the production of stones. The latter experiments as noted elsewhere could not give any conclusive results yet and hence only a mention of it is made here. If any interesting observations are noted later on from these experiments I may take an opportunity of submitting this part of my work later. In the former experiments on rabbits the chief effects of the following have been noticed.

### 1. Obstruction.

- (i) Upper Urinary Tract.
- (ii) Lower Urinary Tract.
- (iii) Effects of foreign body in the bladder.

**1. Obstruction:** In the review on general consideration of Calculi we have said that retention of the crystalloids or the small nuclei formed in the urinary tract is essential for the formation and growth of any calculus. We go to find out the circumstances which help this condition and the most important factor lies in obstruction to the urinary flow. Thus calculus formation forms a part of the "*obstructive syndrome in Urology*".

(1) *Upper Urinary Tract:* Obstruction in the upper tract that is, in the kidney and its pelvis was effected by tying the ureter. Complete obstruction was caused in a series of nine rabbits with ligatures near the pelvis of the kidney in three, one inch from the kidney pelvis in the next three, and just near the bladder in the rest. There were no marked differences seen in any of them attributable to the site of ligature and the series of changes noted at different stages according to the time were more or less similar. Two of the animals died after twenty-four hours and both had convulsions just before death and had passed no urine during the post-operative period. Post-mortem they showed slight congestion in the kidney whose ureter was tied; the bladder was empty. The most probable explanation for this result is that the normal kidney had also stopped functioning being a reflex anuria due to the ligature of the ureter on the other side. The other animals showed dilatation of the ureter, pelvis and kidney above the ligature and the size was proportional to the duration of obstruction. In the early stages, that is, up to a week, the kidney on the side of the ligature showed congestion without any dilatation of the kidney pelvis. The colour of the kidney was purple and the size was double that of the normal side as shown in Fig. 1. Here there is the bladder seen distended in the lower part and that was because a glass bead was put in the bladder at same time when the left ureter was tied. This bead got into the urethra and obstructed the flow of urine out of the bladder. The animal died of uræmia on the eighth day of the operation.

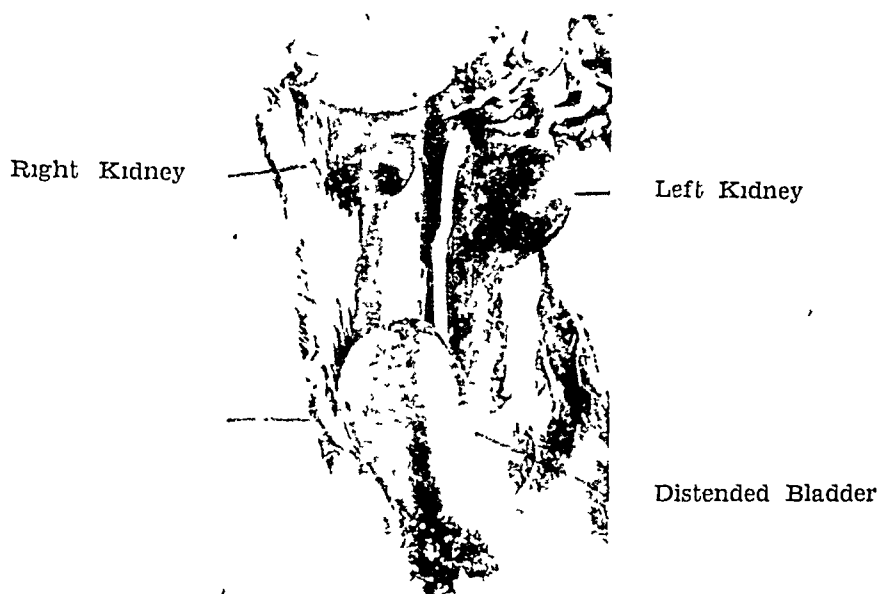


Fig. 1. Showing congestion of Left Kidney of a Rabbit whose ureter was tied eight days ago. The bladder shows retention of urine which was caused by the blockage of Urethra by a bead which was put inside the bladder.

The microscopic section of the kidney showed a copious leucocytic infiltration in the medullary region and there was also a large amount of red blood cells. The areas looked like focal abscesses. No bacteria

could be seen under the microscope though the urine of this animal showed frank pus. One of the areas with these leucocytic infiltrations can be seen in Fig. 2.

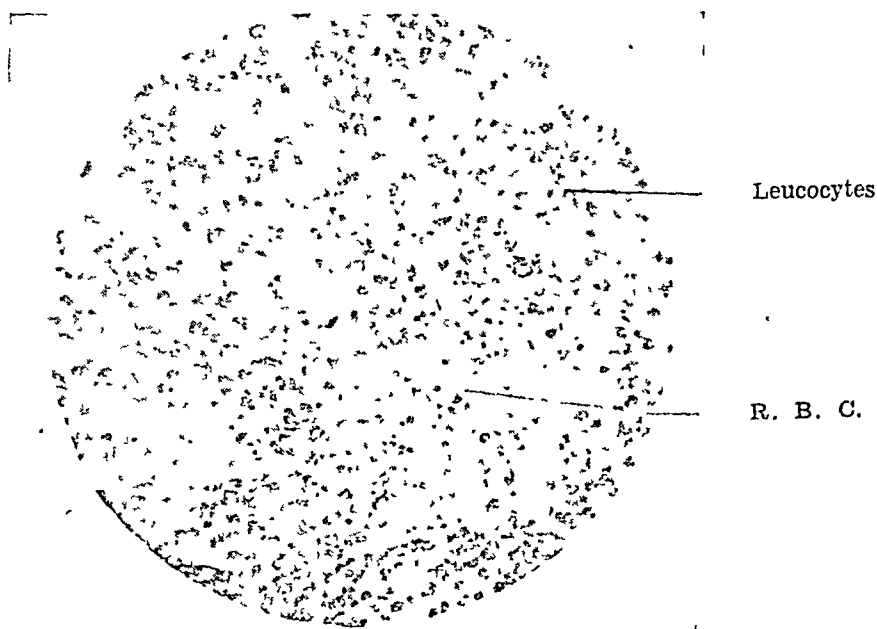


Fig. 2. Submedullary leucocytic infiltration in the kidney of a rabbit with a number of R. B. Cs. seen after eight days of ligature of the ureter.

These spots, I am inclined to think were due to infected abscess formations and not aseptic abscesses as described by Helmholtz. He describes, in rabbits after the ligature of the ureter, leucocytic infiltration of the pelvic submucosa after a few hours and also hæmorrhagic spots due to congestion and obstruction to venous flow due to intra pelvic increase of pressure. These abscesses, he says, break into the pelvis and the condition clears away in about four days' time. There are two things which lead me to the conclusion that mine must be an infected

abscess—First, the animal died on the eighth day of the operation and secondly frank pus was found in urine.

The gross changes seen in the other animals were those of hydronephrosis. There was well marked pelvic and extra renal dilatation four weeks after the operation. The left kidney whose ureter was ligatured at 'A' was about twice the size of the normal kidney as can be seen in Fig. 3. It was pale in colour and the capsule was adherent to the surrounding structures with a definite increase of paranephric fat.



Left Kidney  
Adherent Capsule  
Ligature, "A"

Fig. 3. Kidney, pelvis and upper part of ureter of a rabbit showing hydronephrosis four weeks after ligature of the ureter.

The renal artery on the left side was found to be definitely narrower than on the right. There were several dilated vessels seen in the perinephric adhesions.

The kidney on being cut into two halves showed dilated calyces and pelvis of the kidney. There was thinning of the kidney substance but no differentiation of the

medulla and the cortex of the kidney could be made. These changes can be seen in Fig. 4, where the lower figure is that of the ligatured side and the upper is the normal side. The small figure in the middle and to the left shows a piece of the bladder of the same animal where a stone had formed on a ligature. The latter will be referred to later.



Normal side kidney.

Piece of bladder with the stone sticking to the inner wall.

Hydronephrotic Kidney and Ureter.

"S"

Fig. 4. Kidney of Rabbit showing Hydronephrosis six weeks after ligature of its ureter. A stone in the bladder was also formed in the same animal on a cat gut stitch in the bladder.

The microscopic changes were congestion of the kidney parenchyma with extravasation of Red Blood Corpuscles along with an early aseptic leucocytic infiltration which resembles Fig. 2. which I maintain, is a septic focal leucocytic infiltration. The other



Dilated Tubules.

Degeneration of tubular epithelium showing no nuclei

Fig 5. Section of the kidney of a rabbit taken two weeks after the ligature of its ureter.



Atrophic Tubules

Degenerated tubular epithelium

Fig. 6. Section showing the tubules from the kidney of a rabbit whose ureter was kept tied for six weeks.



Normal Tubules

Fig. 7. Section showing the tubules of the normal side kidney of the same animal as in Fig. 6.



changes are those in the kidney parenchyma and pelvic lining. The kidney tubules are first, to suffer, the reason being a scanty blood supply. The supply of blood in the kidney is primarily coming to the glomeruli and thence to the tubules and hence the glomeruli are the last structures to suffer.

(a) *Changes in kidney Tubules*:—The first change that the tubules show is dilatation and the epithelium shows a sort of waxy degeneration. The nuclei disappear and the walls of completely functionless tubules approximate to each other in a collapse. These changes can be well seen in Fig. 5. Note a comparatively healthy glomerulus

at the right extreme of this figure which shows that glomeruli are affected later than the tubules. This section was made two weeks after the operation.

The late changes in the tubules is a further progress of the changes stated above. The tubules collapse and loose the epithelium till in an extreme case no tubules may be seen throughout the kidney there will be atrophic glomeruli still present. Fig. 6 shows the tubules from the kidney of a rabbit whose ureter was kept tied for six weeks. Fig. 7. shows the tubules of the normal side kidney of the same animal.



Atrophic Glomeruli.

Fig. 8. Section of the kidney of a rabbit whose ureter was kept tied for six weeks. Practically all the tubules are collapsed.

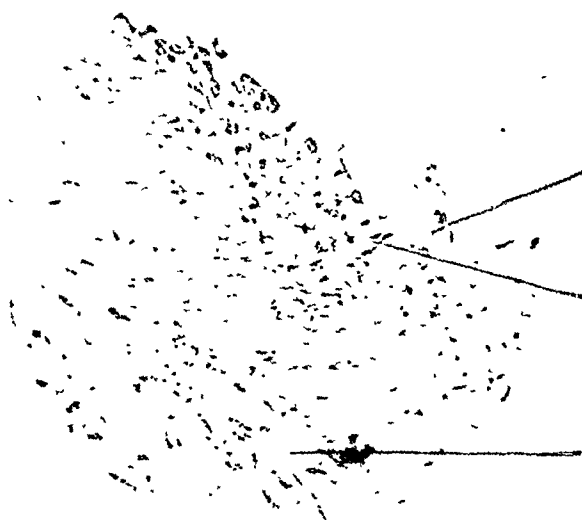
(b) *Changes in the glomeruli*:—In the early stages the glomerulus is seen more or less conforming to the appearance of a normal glomerulus as seen in Fig. 5. Later on atrophic changes begin to show in coincidence with the narrowing of the efferent artery to the glomeruli. The space between the epithelium of Bowman's Capsule and the glomerular tuft increases as

the glomerulus shrinks. Some are more affected than the others till a few may be reduced considerably in size and only a microscopic ghost may remain and the walls of the capsule collapse from all the sides. Such changes could be seen in Fig. 8. Figure 9 shows the contrast picture of the normal side kidney of the same animal.



Normal Glomerulus.

Fig. 9. Contrast picture of the section of the normal side kidney of the same rabbit as in Fig. 8.



Bursting Subepithelial Abscesses.

Leucocytic Infiltration

R.B.C.

Fig. 10. Section of the kidney showing sub-epithelial aseptic leucocytic infiltration with bursting of the epithelium and escape of leucocytes. Large number of R.B.Cs are present at the depth of the tissue.

(c) *Changes in the Kidney Pelvis:*—The gross changes have already been mentioned and are seen in the macroscopic appearance in Fig. 4. The microscopic section in earlier stages shows leucocytic infiltration in the mucous membrane with a large number of red blood corpuscles in the subepithelial region, as can be seen in Fig. 10. The epithelium is seen bursting at many places and the leucocytes seem to be coming out of the irregular crevices thus formed. The appearance conforms to and agrees with *Helmholtz's description of aseptic submuco-*

sal abscess bursting into the pelvis of the kidney and extravasation of blood; I am inclined to confirm his views on the basis of my findings.

Later on the epithelium gets flattened and shows atrophic degeneration with fibrosis and disappearance of nuclei. There is marked fibrosis in the subepithelial region. Fig. 11, shows the pelvic lining from the kidney of a rabbit whose ureter was kept tied for six weeks. Fig. 12 is also given here to show the contrast and it has been taken from the normal kidney of the same animal.

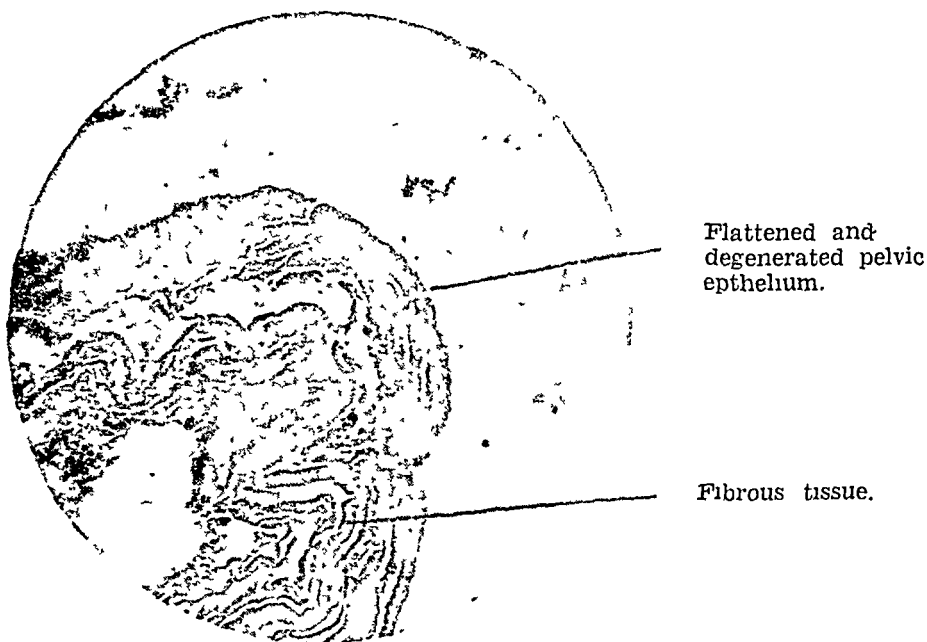


Fig. 11. Section showing the pelvis of the kidney of a rabbit whose ureter was kept tied for six weeks.

(d) *Changes in the Capsule:*—The capsule of the kidney shows thickening and adhesions with the surrounding structures. There are a number of blood vessels in the adhesions and on macroscopic study we find that they are veins chiefly. Microscopic section shows

a thickening of the capsule, fibrosis and adhesion bands through which blood vessels pass. Fig. 13 shows the capsule of such a kidney whose ureter was kept tied for six weeks.

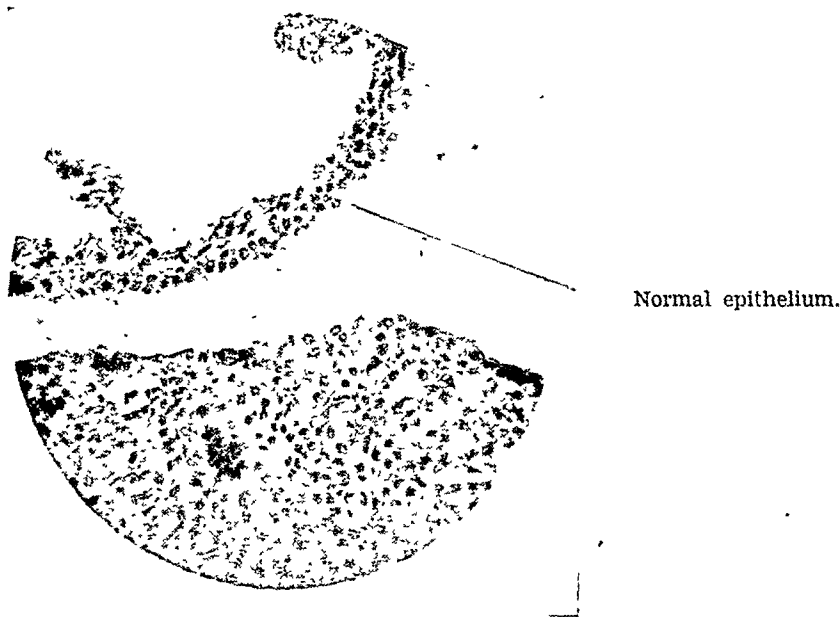


Fig. 12. Section of the normal side kidney of the same animal as in Fig. 11

#### HYDRONEPHROSIS:

The sum total of the above observations leads one to think that complete ureteric obstruction invariably leads to hydronephrotic atrophy of the kidney with the accompanying changes in its adnexa in the case of experimental animals and hence a similar effect may rightly be speculated in men. Almost all the books on pathology mention that complete obstruction of the ureter never produces hydronephrosis and that the kidney undergoes a series of changes called primary Atrophy of the kidney. Secondary atrophy is the name given to the atrophy of renal parenchyma due to infection, degeneration or disuse, while the atrophy seen in cases of Hydronephrosis, though secondary, has been dignified with a separate name, "Hydronephrotic Atrophy".

(a) *Primary Atrophy*:—The erroneous idea in the Medical Books that complete obstruction to the ureter causes at once a primary atrophy of the kidney has arisen from the faulty observations on animal experiments described in older books, such as that of Morris in his book on the kidney. More recent works by Hinman Frank of

California and others show that there is no support to the former view. Not one of his experimental animals showed primary atrophy. The old idea was supported by cases where accidental ligature of the ureter had occurred in human beings. A strong point against complete obstruction always causing Primary Atrophy is the fact that Primary Atrophy has sometimes been noticed in the case of partial obstruction and Barney reports it in one of his experimental animals. Ligatures high up near the pelvis often cause primary atrophy. It occurs more often in the case of a diseased kidney. Thus the description conforms to the condition of calculous anuria. We know that in the latter condition there is a vasomotor spasm of the renal arterioles and thus anuria. Hence if such a vasomotor change causes atrophy of the renal parenchyma we may call it anaemic atrophy. Thus the complete obstruction itself is the cause of the vasomotor phenomenon by virtue of which the anæmic atrophy occurs.

The conclusion that complete ligature of the ureter in man leads to primary atrophy

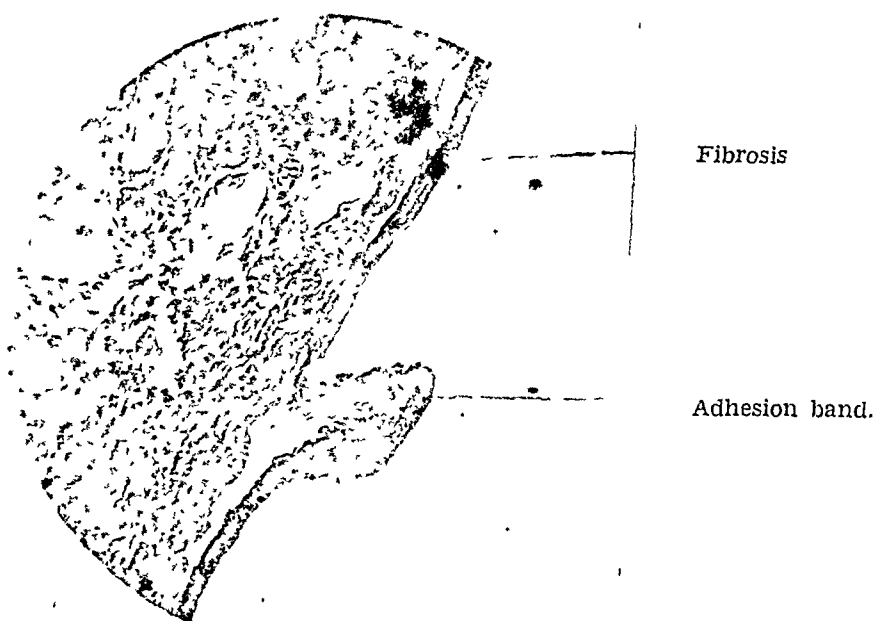


Fig. 13. Section showing capsule of the kidney whose ureter was kept tied for six weeks.

is based on clinical findings. There being no immediate effect noted in the way of pain or infection one naturally has supposed that the kidney has stopped functioning. As we know that hydronephrosis slowly develops and there may be no kidney symptoms till the end such an assumption is very likely. In support of this view I would like to mention a case of Hydronephrosis in which nephrectomy was performed when I was working as a House Surgeon in the King George's Hospital. As a calculus was also found in the hydronephrotic sac it has been included in the 326 cases mentioned in the statistical findings.

**Case 1.** Mohammad Ilyas, aged twenty-three, Book-binder, Male, Muslim, Bachelor, non-vegetarian, residence Moradabad came to the hospital on the 7th April, 1943. His complaint was a swelling in the right hypochondrium, fever and pain all over the body. The duration of this trouble was only eleven days and the patient had never had any

trouble before. No urinary symptoms were present even at the time of his admission. On clinical examination the swelling was found to be intra abdominal and cystic and did not move with respiration. There was no resonance in front of it and it could not be decided whether the swelling was connected with the kidney, the liver or the stomach and duodenum. There was an outdoor diagnosis of Hydatid cyst of the liver and hence Cassoni's test was done and was found negative. A barium Meal and skiagraphy showed nothing abnormal with the stomach and duodenum. A descending pyelography was done last and it revealed complete absence of function of the right kidney and there was a shadow in that region which was suggested to be due to pyonephrosis and a small sharp radio-opaque shadow was seen in its lower part, indicating the presence of a calculus. On operation transperitoneal nephrectomy was performed. The kidney was lying as a thin covering to the hydronephrotic sac and infection of the sac had occurred

which was the cause of the fever and a small calculus was found in the lower part which was a phosphatic concretion. On further inquiry the patient denied any history of pain in the kidney region or any urinary disorders. §

There cannot be a more impressive case than this. Hence in cases of complete ureteric obstruction one can never say if there is Primary Atrophy or a slow, gradual and symptomless Hydronephrotic atrophy. "On looking over the literature including Barney's series, A.E. Belt found 64 cases of complete ureteral ligature, in 20 of which there was no discomfort or trouble following; in 38 there was definite evidence of renal disturbance, either immediate or at some distant time; in 2 there was definitely a slowly growing mass in the kidney area. In 17 of these cases a later examination of the kidney was obtained and 14 showed definite hydronephrosis. In one autopsied case a marked hydronephrosis and hydroureter was present. In 8 cases of ureteral ligature subsequent nephrostomy was followed by instant secretion in all which lends sound evidence to support the view that a kidney with complete ligature of the ureter does not cease activity. One of these obstructions had lasted ten, another eight, one five, and three six days and three twenty-four hours; all recovered". These lead us to conclude that complete ureteral obstruction mostly causes hydronephrosis and secondary atrophy of renal parenchyma even in human beings.

*Obstruction in relation to stone formation:—*  
In one of the experimental rabbits whose kidney is shown in figure 4, there was a jelly like reddish pale body at "S" which on drying and analysis proved to be all organic matter. No crystals could be seen under the microscope. Such a mass, I suppose, would have formed the beginning of some concretion had the animal been kept alive for a longer time. The supply of crystalloids is constant because there is continued secretion and reabsorption of urine and urinary fluid respectively. Obstruction as we have also pointed out enables the nidus to be retained in the passages and thus provides the most

essential factor in the formation of stone. Calculi have been very frequently found in Hydronephrotic sacs and the above mentioned case is a good example.

(2) *Infection:—*In an attempt to establish the relationship between infection and Calculus formation the author took cultures of *Bacillus Colli Communis*, *Staphylococcus Aureus* and *Bacillus pyocyaneus*, and injected them intravenously in three rabbits. All these rabbits died within the third day and post mortem showed a diffuse, severe pyelonephritis. The study did not reveal anything encouraging and the animals could not survive longer, hence these experiments were discontinued.

### (3) *Lower Urinary Tract:—*

(a) *Obstruction:—*In a set of experiments attempts were made to cause obstruction to the lower urinary Tract in the rabbit. Stricture of the urethra was produced by Scratching the external urinary meatus and producing a traumatic stricture. None of the animals could develop an actual obstruction.

In the next series of observations, on Foreign bodies in the bladder, a sterile bead was put inside the urinary bladder of a rabbit. The bead being of a small size passed on to the upper part of the urethra where it got obstructed and caused partial retention. The animal died on the twelfth day of acute uræmic symptoms, the obstruction probably had gone to complete blockage. The bladder of this rabbit was found distended and the urine purulent. On microscopic section the bladder wall showed slight thickening and small crevices which I am inclined to think were the beginnings of the trabeculations which are usually noticed in cases of obstructive retention of urine in the bladder. The section is shown in Fig. 14.

(b) *Foreign Body:—*Attempts (four rabbits) were made to produce experimental calculi on a sterile foreign body as a nucleus but none could succeed. In one of the animals, Fig. 4, we put in the sterilised top of a hypodermic needle to avoid blockage of the

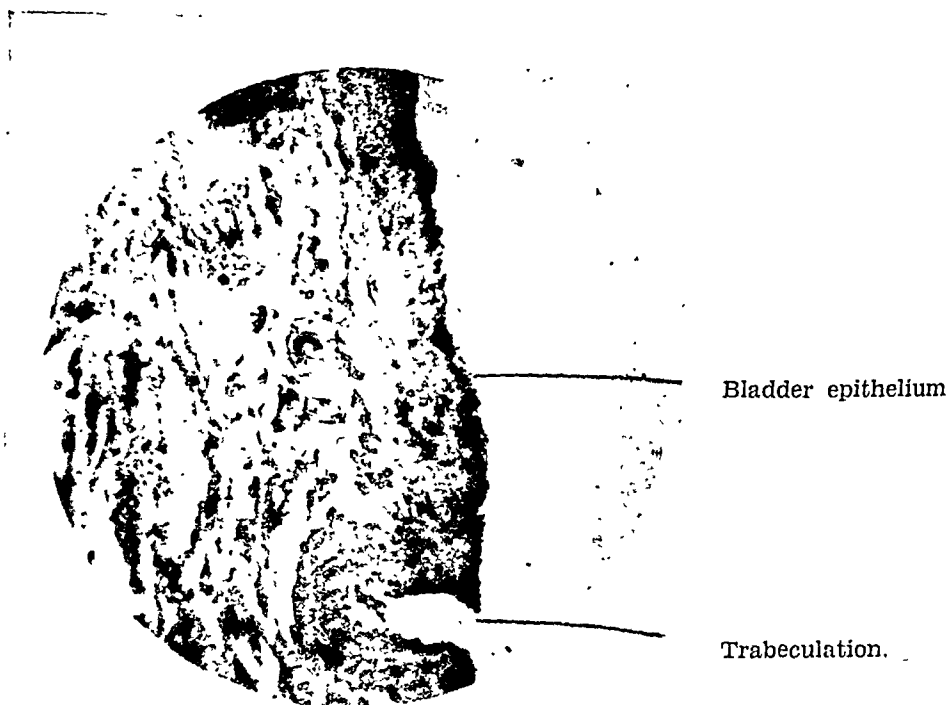


Fig. 14. Section through bladder wall of a rabbit which died of retention of urine due to obstruction to the urethra by a glass bead.

urethra due to its irregular shape and big size. The operation was done by opening the bladder through abdominal route and the bladder wall was stitched up. The animal was killed and opened up six weeks after the operation. The top of the needle was found missing but a calculus was found sticking to the inner surface of the wound in the bladder

wall. It was of the size of a small pea and showed small nodules on the surface. The colour was pale white and was sticking to a catgut ligature. The photo on the extreme left of Fig. 4, shown below in Fig. 4 "A" shows the calculus on the bladder wall as it was found.

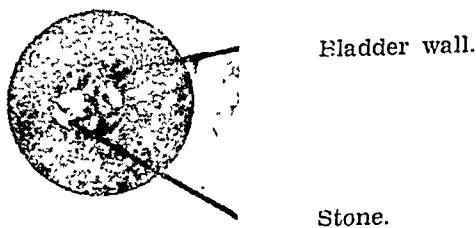


Fig. 4 "A"—Piece of Bladder wall showing a small stone on a catgut stitch.

The chemical analysis of this stone gave the following composition:—

1. Calcium.
2. Carbonate.
3. Phosphate.

The actual proportion of the carbonate and phosphate constituents of this calculus was not determined but on Microscopic examination we could detect a preponderance of calcium Phosphate crystals. The bladder wall

had grown very thick at this place and it showed several puckerings round about where some encrustation could be seen with the aid of a lens. A microscopic section of the bladder wall showed thickening and fibrosis of the subepithelial region of the bladder

wall and denudation of the bladder epithelium while on the surface and in the small trabeculae there could be seen crystalline deposits of Phosphates as can be seen in Fig. 15.

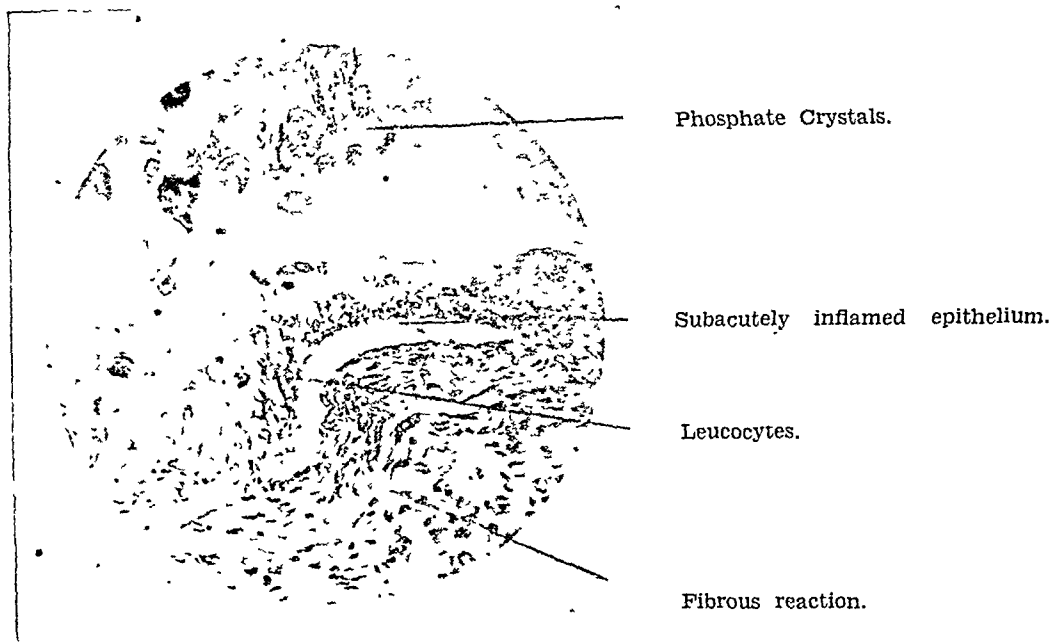


Fig. 15. Showing section through Bladder wall of a rabbit which developed Vesical Calculus around a catgut stitch shown in Fig. 4 "A".

The urine of this animal was found purulent and the deeper layers of the bladder epithelium showed subacute inflammatory leucocytosis.

In human subjects it has been found that stone formation has usually occurred on non-absorbable material in the bladder, but here we have it on absorbable catgut ligature. J. Swift Joly reports one such case in a human patient.

### SUMMARY

A series of animal experiments were done to work out the Etiological factors of Urinary Calculi. The effects of obstruction, infection and foreign body was noted in both upper and lower Urinary Tracts:—

#### 1. Upper Urinary Tract.

(1) *Obstruction*:—The macroscopic changes noticed were an early congestion of the kidney on the ligatured side, which became pale later, and dilation of Kidney pelvis and ureter. Later the Kidney substance became bigger. The capsule got adherent to the surrounding tissues with a definite increase of fat and blood vessels. On section the kidney showed dilated calyces and thinning of the kidney substance round it.

The Microscopic change showed an early submedullary leucocytic infiltration and bursting of the abscesses; this confirms Helmholtz's view. Later, these abscesses get infected. The tubules are the first structures to suffer and they become dilated and the



epithelium atrophies finally leading to a general collapse of the tubules. The glomeruli atrophy later and this is due to their better blood supply. The pelvic epithelium shows flattening and degeneration with a fibrous reaction in the depth. The capsule shows fibrosis, vascularity and adhesion bands.

Thus we see that *all the animals show a hydronephrotic atrophy and none shows primary atrophy.*

(2) *Infection*:—A general pyelonephritis occurred in all the cases where intravenous bacterial emulsions were administered to the animals.

## 2. Lower Urinary Tract.

(1) *Obstruction*:—Showed a fibrosis and trabeculation of the bladder wall.

(2) *Infection*:—It was not done separately but it got superadded in the next series of experiments on Foreign bodies.

(3) *Foreign Body*:—Foreign bodies in the bladder provide a ready made nucleus for the colloids to deposit. We got a Phosphate and Carbonate Calculus actually formed on a cat-gut ligature. Infection hastens the growth of such a stone.

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# NERVE—GRAFTS

By

*Major H. R. PASRICHA, I.M.S.*

During the repair work of injured peripheral nerves, it is of utmost importance to secure end to end approximation of nerve ends. In spite of all efforts, it may not be possible to secure such approximation.

The only alternative left for bridging the gap in the nerve is nerve graft of some kind. In peripheral nerve injuries due to war wounds the percentage of cases where approximation is not possible is fairly high, on account of the extensive damage caused by missiles of various kinds. At the peripheral nerve centre at 7, I.B.G.H., Poona, where all nerve injuries were treated, this was our experience. Quite a large number of nerve grafts were used to bridge gaps of this kind. A few were of the whole nerve type, but a larger number were of the cable type. In the former portion of a big nerve which can be sacrificed is used; in the latter several small lengths of an unimportant, cutaneous nerve are used.

After the 1914-1918 war, the Medical Research Council in England appointed a committee on injuries of the nervous system. Their first report appeared in 1920. About nerve grafts it said, "it is of the utmost importance that every manœuvre should be employed and every means exhausted for securing end to end approximation before trying the last resort of grafting. This investigation has shown that in exceptional cases grafts have produced more successful results than previous experience had justified any hope for."

After this, Ballance and Duel (1932) recorded successful recoveries in autogenous grafts of facial nerve. Experiments tried with homografts by several workers in man have proved unqualified failures. (Seddon and Holmes, 1944; Barnes, Bacsich, Wyburn and Kerr); autogenous graft is the only type of nerve graft which can be used with some hope of

success. The results are more successful if the nerve to be bridged is small in calibre as for example facial or digital. (Duel, 1933; Bunnell and Boyes, 1939; Collier, 1940). In larger nerves where Cable grafts have been employed, the pathway provided for nerve regeneration cannot be very satisfactory.

The following are the results of 7 cases whose records are available the others lost their patience and refused to stay in hospital long enough to permit sufficient recovery of the nerves.

The grafts included the following:—

1. Median nerve	..	..	2
2. Ulnar	..	..	1
3. Tibial			1
4. Peroneal	..	..	4
			—
			8

The case summaries of the cases are given below:—

Case 1. Median nerve graft (whole nerve).

R/M. D. R. 1/7 G.R. sustained machine gun wound of the Rt. arm on 21-3-44. Arrived in the centre on 16-9-44. Complete Median and Ulnar lesion in the arm. Had an extensive puckered scar on the medial aspect of Rt. arm. There was considerable destruction of muscles and other structures under the scar. The scar was overlay bare bone. Within the next two months a skin tube was constructed on his chest and transferred to the Rt. arm after the excision of the scar. 15-11-44 arm explored. Both Median & Ulnar nerves completely divided. Ulnar gap 12 c.m., Median 10 c.m. Ulnar used as grafts. 10 c.m. were removed and the gap in the median filled up. Buried in muscle. First sign of recovery appeared in January 46; 14 and half months after operation. On 31-10-46 when he was discharged due to his refusal to stay

any longer the state of his muscles was as follows:

Pron. Teres ..	..	3
Flex. Carpi. Rad. ..	..	4
Palm. long ..	..	4
Flex. sub. dig. ..	..	3
Flex. prof. dig. ..	..	3

Also he had protopathic sensation in the median area of the palm.

#### Case 2. Median Nerve graft. (Whole Nerve).

Sep. S.S. 5/1 P.R. sustained grenade wound Lt. Forearm on 19-4-44. Arrived at the centre on 20-10-44. Explored on 29-11-44. Complete lesion of both Median & Ulnar. Both gaps nearly 12 c.m. Ulnar used as grafts. Length of graft 3.5 c.m. Discharged on 5-10-45 because he refused to stay longer. No recovery.

#### Case 3. Ulnar Nerve Graft. (Cable).

R.M. P.B. 4/4 G.R. sustained G.S.W. Lt. arm on 2-3-45. Arrived centre 22-6-45. Exploration 17-9-45. Revealed a complete lesion of Ulnar in the arm. Gap after resection 17 c.m. Medial cutaneous of the arm used as nerve graft. Owing to length of the gap only two strands could be sutured in. Buried in muscle. Discharged on 18-11-45 on account of dissolution of this centre. The following muscles were contracting.

Flex. Carpi. Ull. ..	..	3
Flex. Dig. Prof. ..	..	3

Also he had protopathic sensation in the Ulnar area of the palm.

#### Case 4. Tibial Nerve Grafts. (Cable).

L.Nk. L.B.G. 1/5 G.R. sustained G.S.W. Lt. knee on 14-12-43 arrived centre 9-7-44. Exploration 5-8-44. Complete lesion of both tibial and Peroneal. Peroneal sutured. Tibial gap 11 c.m. Lower neuroma between the two heads of gastroc. Posterior cutaneous of the thigh and sural cutaneous used for bridging the gap. Buried in muscle. Discharged on 2-11-45. Peroneal had recovered while Tibial showed partial recovery. Only Gastroc. contracted (3) There was no recovery of sensation.

#### Case 5. Peroneal Nerve Graft. (Cable).

Sep. S.S. 5/16 P.R. sustained G.S.W. Lt. thigh on 26-8-44. Arrived centre 11-1-45. Exploration on 13-6-45. Revealed peroneal completely divided. Gap 9 c.m. But approximation not possible, on account of limitation of knee flexion. Sural cutaneous nerve used as graft. Buried in muscle. Discharged 4-9-46. No recovery at all.

#### Case 6. Peroneal Nerve Graft. (Cable).

Gnr. K.S. R.I.A. sustained mortar wound of left knee on 18-1-45. Resulting in Compd. Fracture Femur. Arrived centre 13-9-45. Fracture united but had lesion of peroneal nerve. Exploration 6-2-46 Completely divided peroneal nerve. Gap 12 c.m. Sural cutaneous used as grafts. Three lengths of 5 c.m. each inserted and approximation obtained by flexion. Buried in muscle. Discharged on 26-11-46 on account of dissolution of centre. No recovery at all.

#### Case 7. Peroneal Nerve Graft. (Cable).

Sep. K.A. 4/5 M.L.I. sustained Grenade wound Rt. thigh, resulting in Fracture Femur on 6-6-44. Arrived centre 12-5-45. Fracture united but marked limitation of knee flexion. Exploration on 3-6-45. Revealed a complete lesion of Peroneal. Gap after resection 9 c.m. Approximation not possible on account of limitation of knee flexion. Cable nerve graft from Post. cutaneous and sural cutaneous. Discharged on 26-11-46 on account of dissolution of centre. Peronei were acting. Power 3. No other recovery.

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# HYDATID CYST OF INNOMINATE BONE

By

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J. L. R. Kneebone in Australia in an analysis of 59 cases of hydatid disease in Australia gives the frequency of the disease in different parts of the body as follows:—


Liver	..	..	..	35 cases.
Lungs	..	..	..	16 cases.
Pelvis	..	..	..	4 cases.
Muscles	..	..	..	3 cases.
Subcutaneous Tissue	..	..	..	1 case.

signs and symptoms are modified because of the resistant nature of bone. Bone formation is inhibited resulting in solid masses of hyaline material resembling grains of boiled sago. The affected bone expands in globular or fusiform manner. The development of the disease is so slow that no new formation of bone occurs. Pathological fractures may be the first sign of the disease—this leads to the dissemination of the disease into the soft tissues.

By X-Ray examination it is difficult to distinguish hydatid cyst from Osteitis Fibrosa Cystica. In the case cited below if the patient had not developed an Ischio-rectal abscess which discharged cysts on being opened, it would have been very difficult to diagnose it clinically. The whole of the left innominate bone was affected involving the acetabulum with fracture of the neck of the left Femur.

## CASE REPORT:

The patient, aged 50 years, was admitted for pain in the left lower limb—duration 5 years. The pain started from the left buttock and radiated down the anterior part of the thigh. Later it extended to the legs and made walking impossible. On examination the patient kept his left thigh and leg flexed. There was slight wasting of the muscles of the left lower limb and limitation of active movements at the left hip-joint. On palpation there was tenderness all round the hip and the trochanter was slightly raised and thick. Passive movements were also limited and there was a rough grating sensation palpable in the region of the hip-joint which gave an indication of fracture of the neck of the femur. Rectal examination revealed a spherical hard lump palpable in the anter-



Hydatid cyst of the right side of Innominate bone, involving the acetabulum, rami, head and neck of Femur.

Two cases were under 10 years, two over 70. There were 9 cases between 50 and 60 years.

Bone is one of the rarest sites where hydatid disease occurs and the bones affected are Femur, Vertebra, Tibia and Innominate bones. The disease progresses very slowly and the

ior and the left quadrant of the pelvis. The mucous membrane and wall of the rectum was movable over the lump. The latter was fixed to the wall of the pelvis and not tender. The general condition of the patient was slightly run down and walking was only possible with the help of a stick.

X-Ray of the pelvis and left hip-joint:—

Destruction with patchy and marginal calcification in the region of the body and ramus of the pubis and ischium and acetabulum with central pathological dislocation of the head of the Femur which also shows similar bony changes.

There was pathological fracture of the neck of the femur. Puncture biopsy of the tumour was done through the rectum and watery fluid was found to spurt out through the cannula. The fluid revealed a few R.B.C.

as the specimen collected was slightly mixed with blood. The patient developed an Ischio-rectal abscess after some days which was operated on and was found to contain foul smelling pus and a large number of cysts of varying sizes along with the membranes of the cyst wall; crumbling pieces of bones were also discharged with the pus. On introducing a gloved finger the whole of the left side of the pelvic bone was found to be excavated. The cyst and the membranes were confirmed on microscopic examination to be those of hydatid. Pus showed gram negative bacilli and gram positive cocci in pairs and clusters. The patient developed a sinus in the ischio-rectal fossa which was dressed daily, and a strapping extension was applied to the left lower limb. His condition deteriorated due to continued sepsis of the bone in spite of several courses of penicillin and Cibazol tablets.

# A REPORT OF TWO CASES OF PEDICULATED SPLEEN

By

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and

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We are not aware of any mention made of cases of pediculated Spleen in the literature with the exception of a casual small note in the Lancet, a couple of years ago, by a Surgeon from South America, under the name 'Pelvic spleen'.

About a year earlier than that we had met our first case.

## CASE REPORT I:

In January 1944 a young woman of 30 years, was admitted for a tumour in the abdomen which could be moved about all over. One could easily place it in the right hypochondrium, right iliac fossa, left iliac fossa, left hypochondrium or in the centre of the abdomen. The tumour was firm to palpation. It was not tender or painful. Since there was no history of menstrual disturbances, it was diagnosed as a sub-peritoneal pedunculated fibroid of the uterus. Her general condition was good. A laparotomy was performed on 27-1-44. On opening the peritoneal cavity the tumour showed itself prominently; it could be easily lifted out of the abdomen; it had nothing to do with the uterus or the ovary; it had a long pedicle, and it was realised that it was a spleen. The pedicle was ligatured and the spleen removed. The abdomen closed. The amount of blood that flowed out, after

the removal of the spleen, was about  $\frac{1}{2}$  oz. The size of the spleen was about the size of No. 1 football. The patient made an uneventful recovery. She is alive and well.

## CASE REPORT II:

A woman aged 20 years was admitted with a tumour in the abdomen which could be moved about fairly easily. When first seen it was in the right kidney pouch. No history of menstrual disturbances. Had only one pregnancy 6 years ago.

On vaginal examination nothing specific could be made out. On the day of the operation i.e. on 11-3-47 the tumour was felt in the left kidney pouch and one could easily move it about all over the abdomen. It was again diagnosed as sub-peritoneal pediculated fibroid. The general condition of the patient was good. No history of attacks of malaria of late. W. R. + + +. Previous to the operation a course of anti-syphilitic treatment was given. On 11-3-47 a laparotomy was performed and the tumour lifted out of the abdomen. It was found that it was a spleen with a long pedicle. The pedicle was ligatured and the spleen removed. The spleen, measured 16" x 9", and weighed 26 ounces. The amount of blood lost was about an ounce. She made an uneventful recovery.

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# A CASE OF CERVICAL MENINGOMYELOCELE

By

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The following case of cervical meningo-myelocele is reported as these cases are comparatively rare and also because this particular case presented many interesting features.

The patient, a boy aged eleven, was admitted on 13-10-43 for a swelling on the lower half of the back of the neck. He stated that it had been present since birth, and was gradually increasing in size but more rapidly within the past three months and the overlying skin had now ulcerated. His left upper and lower limbs had been weak from birth.

The patient was an intelligent boy in average good health. There was a translucent uniform globular swelling three inches by three inches over the back of the lower half of the cervical region. (Fig. 1) The skin over it was ulcerated and it was fixed to the deeper structures in the centre of its base. The swelling did not get reduced on pressure nor did it become tense on crying or on pressure over the jugulars. The anterior and posterior fontanelles had closed and the size of the head was normal. No other associated congenital abnormality was present. On examination of the nervous system it was seen that he had a hemiplegic gait. The left upper and lower limbs were spastic and tendon jerks were brisk. Plantar response was flexor. Power in the lower limb was markedly diminished. He had wasting and weakness of all the muscles of the left upper limb especially the scapular and hand muscles. (Fig. 2) Both subjective and objective sensations were normal.

X-Ray of the cervical spine was taken. (Fig. 3-A and B) The lateral view revealed the normal cervical curve; the spinous processes of the C-3, 4, 5, were bifid and the

swelling appeared to be pedunculated. Antero-posterior view showed the defects in the spines of C-3, 4, 5.

The ulcers on the skin were treated and healed. The operation was done under C-2, E-3. The operative findings were (1) Separation of the laminae and halves of the spinous processes of the 3rd, 4th and 5th cervical vertebrae. (2) A Meningocele sac which appeared to be formed of dura, arachnoid and pia. (3) Nerve roots were present. The dura was excised and the remaining membranes sutured together in the gap to facilitate their function of absorption of cerebrospinal fluid. The patient recovered from the operation but his hemiplegia showed no immediate improvement. After one year he was seen again when his gait had become almost normal but there was no improvement in the upper limb. No hydrocephalus was present.

## COMMENT:

The interesting points in this case are:

- A. Its comparative rarity.
- B. The age that the patient had reached without treatment.
- C. The type of paralytic symptoms produced.
- D. The good health and normal intelligence of the patient.
- E. The absence of hydrocephalus after operation.

## A. THE COMPARATIVE RARITY:

Spina bifida is most common where normally union of the edges of the neural groove is latest, namely in the cervical spine and more especially in the lumbar regions of the spine. In a study of the Surgeon-General's index upto 1905, of 385 operated cases, Moore

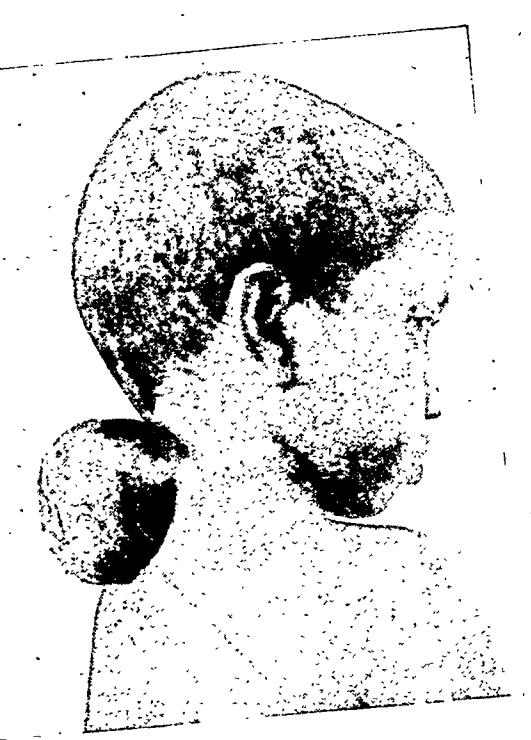


Fig. 1

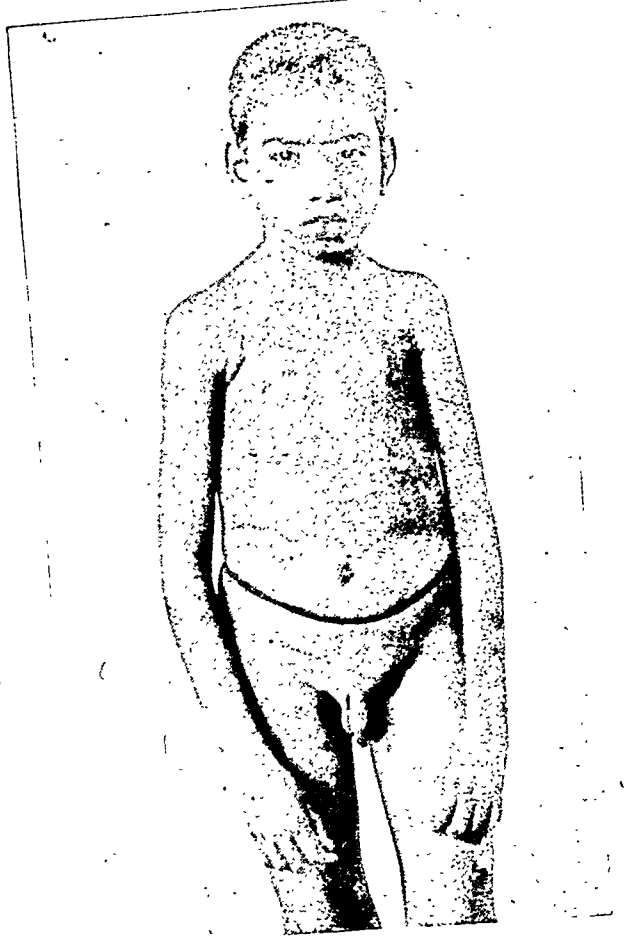


Fig. 2



Fig. 3 (A).



Fig. 3 (B).



found that 233 were sacral, 34% were lumbar, 29% lumbosacral, 9.5% cervical, and 4.5% thoracic. Two cases were occipital meningo-coeles (Christopher-1944). The relative frequency of lumbar and sacral defects is however not more than 70% in most statistics.

Fraser's 'Surgery of Childhood' gives a clinical photo of a large cervical spina bifida of the meningocele type in a young child. Christopher illustrates a cervical spina bifida with meningocele in an infant. With regard to the percentage of pure meningocele, opinions differ. Kolodug in 79 cases found 44 meningoceles (36%) while in the 37 cases of Gross and Sachs, there were 20 meningoceles (35%). These findings were based upon patients who were operated on. In Elsberg's experience only 20% were pure meningoceles. This case was a meningomyelocele.

#### B. THE AGE OF THE PATIENT:

Woolsey in Keen's Surgery states that most cases fortunately die early. Of the 649 children who died in England in 1882, 112 died within the first year; among 90 cases not operated on, the majority died within the first few weeks. Only 20 lived to be over five years of age. Most cases living 5 years or more are meningoceles. The clinical photographs given in Keen's & Christopher's textbooks of surgery are both of small infants—an infant with a meningocele and without any neural lesion may live to adult life without symptoms. This case is remarkable as being a myelomeningocele with paralytic symptoms, the patient still lived in comparative comfort for 11 years till the skin began to ulcerate.

#### C. THE TYPE OF PARALYTIC SYMPTOMS PRODUCED:

The symptoms in this boy were unusual; namely, (1) spasticity, (2) loss of power in upper and lower limb, (3) no sensory loss. Even in cervical spina bifida loss of power in the upper limbs is rare. This is probably due to the fact that most of the cervical and thoracic defects are meningoceles. It is not unusual for the abdominal muscles to be without tone in many of the cervical and thoracic lesions. The loss of power in the

lower limb varies from dropped foot on one or both sides to complete flaccid paraplegia. The tendon reflexes cannot usually be elicited. Sensory disturbances are common; Kinnier Wilson states "In occipito cervical cases, clinical pictures, not unlike that of Syringomyelia, is fairly common. It may be confined to one upper limb, or include amyotrophy of the arms and paraplegia of the legs; both motor and sensory symptoms are capable of great variation." Fraser states "If the spina bifida occurs in the cervical and upper dorsal regions, the paralysis may be a spastic one and sensory changes are invariably present if a motor lesion exists." Here there was spasticity with no sensory disturbance.

#### D. The indications for operation are:—

(a) All infants with meningoceles should be operated on whether or not they have neurological signs. (b) It is now regarded that all infants with paralysis of one or both lower limbs should receive surgical treatment unless the paralysis of one or the other limbs is complete. Paralysis of the vesical and rectal sphincters is not a contra-indication to operation in spite of the fact that complete recovery does not occur. As there is regular association of the Arnold-Chiari-malformations with lumbar meningomyeloceles, decompression of the occipito-cervical region is required.

#### E. THE ABSENCE OF HYDROCEPHALUS AFTER OPERATION:

The occurrence of hydrocephalus after operations for meningocele has been attributed by various authorities to different causes. One thought that it was due to deficient absorption of cerebrospinal fluid, caused by the removal of the meningeal lining of the sac, and advocated pleating of these membranes instead of excision. This was done in the case here reported which after two years showed no tendency to hydrocephalus, and no deterioration in intelligence.

Histologically it has been shown that the sac is composed of collagen tissue resembling arachnoid. Thin-walled veins are also seen. Large clumps of cells with large nuclei are found and are in intimate contact with blood

vessels resembling the arachnoid villi and Pacchionian bodies and it has been demonstrated that the tissue spaces in the sac communicate with the sub-arachnoid space. Hence it is found that absorption of C.S.F. into the blood stream takes place within the sac. The arachnoid tissue of the sac may provide for so much absorption of C.S.F. that the normal arachnoidal system in the cranial cavity may be improperly developed and hence when the sac is removed, the C.S.F. absorption does not keep pace with the formation resulting in a hydrocephalus. Elsberg on the other hand thinks that operative technique has little effect on the formation of hydrocephalus. He explains its occurrence by the presence of a pre-existing Arnold-Chiari-malformation. Norman Dott also agrees with this view.

Arnold in 1894 and Chiari a year later noted herniation of hindbrain through the foramen magnum commonly in cases of meningocele and meningomyelocele. Russel and Donald (1935) noted their findings in ten post-mortem examinations and described a tongue of cerebellum and medulla complete with choroid plexuses and enclosing an elongated fourth ventricle, protruding downwards through the foramen magnum and lying in the posterior surface of the spinal cord. The cervical nerve roots pursued an upward course instead of downwards to their normal exit, indicating that the whole cord was displaced caudally. Associated malformations as hypoplasia of the medulla, non-differentiation of vermis into lateral lobes and closure of the aqueduct of Sylvius and foramina of Magendie and Luschka are seen. The herniation may give rise to a communicating or non-communicating variety of hydrocephalus. Penfield and Coburn suggested that the spinal cord being fixed in the region of the spina bifida did not rise as the baby grew resulting in a pressure cone. Ingraham and Scott in twenty autopsies describe in addition to the observations of Russel and Donald the co-existence of a plastic meningeal exudate microgyria and defects in the skull. The latter is demonstra-

ble radiologically. Jefferson while operating on an adult with the symptoms of a high cervical tumour noticed an Arnold-Chiari-malformation. X-Ray of the spine revealed a sacral spina bifida and Jefferson suggested decompression of the herniated hindbrain by removal the posterior part of the bony canal an operative procedure which can be performed at any age. The lower part of the Occipital bone, the posterior part of the foramen magnum and the posterior arches of the cervical vertebrae are removed to below the level of the lower edge of the medulla and the dura is widely opened.

It is suggested by Jefferson that this operation may be performed 10-14 days after the meningocele operation. Dott does the decompression before operation on cases of spina bifida. Steele records a successful case of Cerebello-medullary decompression in a baby 7 months old who developed hydrocephalus after a meningocele operation.

#### SUMMARY:

A case of cervical meningo-myelocele operated on at the age of 11 is described; a large number of cases of spina bifida have been operated on in the lower lumbar regions; only one has been seen in the cervical region.

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# A CASE OF LYMPHOSARCOMA OF THE ILEO-CAECAL REGION WITH SPECIAL REFERENCE TO THE TECHNIC OF ONE STAGE RIGHT HEMICOLECTOMY

By

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## Case Report:

A Mohammedan male, 28 years, tailor by profession and a resident of Lucknow, was admitted to the King George's Hospital, Lucknow on 17-3-47 with the complaint of a gradually increasing swelling in the right lumbar region of 3 months' duration. The swelling was freely movable and was associated with colicky abdominal pains which had been present for about six months before the appearance of the swelling. He gave no history of bowel irregularity. His family history and history of past illnesses were of no special significance.

## On Examination:

The patient was a thin built man of good colour. His upper alimentary tract was normal. Abdominal examination showed an intra abdominal mass 3" X 4" situated in the right lumbar region. The surface was smooth and the margins were rounded and well defined. It was firm in consistence—slightly tender but moved very freely in both planes. It could be brought down to the Iliac fossa and towards the umbilicus. It could not be however pushed back into the region of the kidney. It was dull on percussion. The physical signs were suggestive of a movable kidney but the anatomical position of the tumour and absence of a definite renal colic were against such a diagnosis. The other possibilities were tuberculosis or a growth associated with the caecum or a mesenteric cyst. Liver and spleen were normal. There was no fluid in the abdomen and rectal examination was normal.

## Special Investigations:

1. Blood Urea—43 mgm%
2. Urea concentration test = 3%
3. Descending Pyelography = pelves and ureters of both kidneys normal.
4. Straight skiagram of the abdomen was quite normal.
5. Urine culture—sterile.
6. Urine examination was normal.
7. Blood count R.B.C.:—5.2 millions/cumm.  
Hb. 110%—W.B.C. 13,040/cumm.  
Polys 78% Ly. 20% E. 2%
8. Opaque enema:—did not go beyond the hepatic flexure of the colon. There was a complete block in the Ascending colon and caecal region.

With a provisional diagnosis of a neoplasm of the caecum the patient was prepared for laparotomy and resection of the right half of colon.

## Pre-operative Preparation:

Sulphaguanidine grams two by mouth four hourly for four days before operation.

High rectal retention enema of Grams 20 sulphaguanidine in 8 ounces water once a day for four days before the operation.

Indwelling duodenal tube.

Continuous drip I.V. saline.

**Operation:****Incision**

A right oblique subcostal incision was made 8 inches long and 2 inches below the costal margin starting from the mid line and extending laterally into the flank (Wangenstein). The muscles of the anterior abdominal wall were divided in the direction of the incision. The rectus muscle was divided transversely and the epigastric vessels caught and ligatured and the peritoneum incised. The exposure by this incision was excellent. A large firm round tumour was found involving the terminal ileum and the cæcum was stretched over the tumour. No glands were palpable in the mesentery and the rest of the viscera were normal. Right hemicolectomy was decided upon and performed fairly rapidly. The resection was done by the aseptic technique using a Ferniss clamp. The ends of the ileum and transverse colon were closed and invaginated. A side to side anastomosis was performed between the ileum and transverse colon. The closed ends of transverse colon and ileum were sewn to the bowel to stabilise the anastomotic site and prevent rotation. The abdomen was closed. The divided oblique muscles of the abdomen and the rectus muscle were sewn with chromic catgut. The operation took about 45 minutes in all and the patient suffered from very little shock.

**Postoperative Treatment:**

I. V. drip glucose saline 5 pints in 24 hours.

Hourly aspiration of the stomach and duodenal contents.

On the following day the patient was perfectly well and peristaltic sounds were audible.

He was fed on fruit juices every hour and the Ryle's tube was removed. Gradually fluids by mouth were increased.

The patient was out of bed on the third day of the operation for ten minutes and this was done daily afterwards for longer periods of time.

On the fourth morning a glycerine enema was given with a good result.

The patient ran an uneventful course and was quite well. On the sixth day he was put on soft diet and gradually worked up to his normal diet. He was discharged with a healed wound on the tenth day of resection.

A large tumour 3" X 3" was found in the mesentery of the terminal ileum. The growth was infiltrating the wall of the ileum and cæcum and narrowed the lumen to a very narrow crevice. To the naked eye the tumour on section was greyish white in colour and homogeneous in appearance and was vascular in parts.

**Microscopic Examination:**

Showed a lymphosarcoma of the malignant lymphocytoma variety. There was a certain degree of reticulum in the stroma but it was irregularly distributed. The cells were mostly of the small round cell type. Nuclei were compact and hyperchromatic in the majority of the cells but there were interspersed larger cells some of which were multinucleated with large vesicular nuclei and prominent nucleoli. The neoplastic process had infiltrated and destroyed the normal structure of the bowel. Remnants of the muscle coat could be seen frayed out in places. The tumour however had not ulcerated into the lumen of the bowel although lymphoid tissue formed the lining of the bowel lumen in the region of the growth.

**Technique of one stage Hemicolectomy:**

With the advent of sulphasuccidine and Wangenstein's intestinal intubation technique a one stage resection of the colon especially of the Right half, is the operation of choice.

It reduces the duration of stay of the patient in the hospital and also the special care and nursing as required in a Mickulicz resection with an ileostomy and colostomy.

The operative technique is much simpler and the stay in hospital shorter than when the operation is done in two stages with an ileotransverse colostomy as a first stage

procedure followed by resection later on. The two great bugbears of colonic surgery, peritonitis and hæmorrhage are checked by sulphasuccidine premedication and using the aseptic technic of colonic resection. With an indwelling duodenal tube and suction the almost fatal complication of gastric dilatation is a rare event.

Until quite recently some of the private clinics abroad, whose motto had been to reduce the patient's hospital stay to a minimum with the lowest mortality figures, were resorting to a Mickulicz exteriorisation operation in neoplasms involving the right half of the colon. This was the operation of choice at the Lahey clinic and at Mr. Rodney Maingot's clinic at South End in London. During the author's recent visit to the Lahey clinic he found that they were resorting more and more to a one stage resection for cæcal growths. For growths of the left half of the colon, however, a preliminary defunctioning colostomy of the Devine type or with a slight modification, is the procedure of choice followed by resection and anastomosis at the next stage and later closure of the colostomy wound. Again the colon proximal to the site of the lesion is irrigated out daily by sulphasuccidine suspension by means of a small rubber tube passed through the colostomy opening.

In right sided growths obstruction is not so frequent and so a preliminary decom-

pression is not necessary. However, in some clinics, they pass a Miller Abbott's tube down to the site of lesion and wash out the bowel proximal to it with a suspension of sulphasuccidine. The distal portion of the colon is irrigated as usual with a high rectal retention enema of sulphasuccidine as has been mentioned in the case described. The Mortality figures of Dr. R. B. Cattell at the Lahey clinic for right hemicolectomies is under 2%.

The wide subcostal incision (Wangenstein's) used in the case described may arouse some comment but the author has assisted at and followed up several cases in whom such an incision was used by Mr. Rodney Maingot with excellent results. The greatest delight to the operating surgeon is the exposure which the incision provides. The only nerves which are cut are the 9th and the 10th but from what the author has observed abroad and from the experience of other surgeons he never saw an incisional hernia. The case described is quite well and there is no evidence of an incisional hernia so far.

The author is grateful to Mr. Rodney Maingot of London for the practical experience he gained under him in abdominal surgery while he worked as one of his surgical registrars. The operative technic and post-operative care is according to the routine followed at Mr. Maingot's Southend clinic.

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# THE ROLE OF ENTAMOEBA HISTOLITICA IN TROPICAL SURGERY

By

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and

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A Surgeon practising in the tropics has problems peculiar to the country he is living in. Time and again infections by the entamoeba histolytica, the malarial parasites, ankylostomes and round worms have played their part in either producing symptoms akin to appendicitis, cholecystitis or gastric ulcer or it may be, they have given rise to the above diseases. Invariably these cases yield very easily if recognized and treated conservatively with the necessary measures. It is a problem sometimes that one has to face when an acute case appears, whether to operate or to stay one's hand. Every time if one can possibly wait and put off the operative procedure one would do very well indeed! but there are occasions when an operation cannot with safety be put off; then the follow up on the right lines would be a very necessary step.

Previously one of us (Dr. N. A. A. in collaboration with others) had reported cases of ankylostomiasis and malaria mimicking appendicitis. (Vol. 4, No. 4, *The Indian Journal of Surgery*) Michael Smith has reported a case of amœboma mistaken for carcinoma of the colon, in the *Lancet*, 14th September 1946. In the *Indian Medical Gazette* December 1946, Sen Gupta reports a case of pulmonary amœbiasis.

In the course of our work here we have found a few cases in which the entamoeba histolytica has brought about symptoms of appendicitis and cholecystitis. Illustrative case reports are appended below. In most of these cases pain and tenderness are complained of in the right kidney pouch.

## CASE I:

Mrs. H, 25 years. Had two attacks of typical acute appendicitis. Previous history of dysentery present.

On examination of stools amœbic cysts found. Operation deferred and treated with emetine injections and entero-vioform. She has not complained of any further attacks.

## CASE II:

M. aged 35 admitted with a history of acute appendicitis on the 6th day of the attack. Treated conservatively to overcome the attack. Patient was advised to come to the hospital during the quiescent period. After three months he came with an attack of acute cholecystitis. Again he was treated with conservative methods till the acute attack passed off. In the usual course his stools were examined and entamoeba histolytica cells found in plenty. A course of emetine was administered. The patient did not appear for a period of six months. One evening at about 4.0 o'clock he was brought to the hospital with a history of acute pain in the right iliac fossa since 2 hours. Vomiting +; rigidity R.I.F. +. The previous history of the patient did not then occur in the light of the acute attack. An operative procedure was fixed as an emergency. The operative findings were acutely inflamed appendix and colon. For 4 days he did well; on that day he complained of severe pain in the abdomen. It was then that the Pathologist of the hospital just identified the individual and referred to his record when he discovered that his stools had previously shown quite a large number of amœbic cysts,

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### SUBJECTS FOR DISCUSSION

#### 10th Meeting:

##### 1. Spinal Tumours.

Opener: Dr. R. G. Ginde, Bombay.

Seconder: Dr. R. N. Cooper, Bombay.

##### 2. Talipes Equinovarus—

Opener: Dr. R. Kalamegam,

Trichinopoly.

Seconder: Dr. M. Bahadur Khan,

Hyderabad.

##### 3. Surgical Complications of Typhoid—

Opener: Dr. V. G. Vaishampayan,

Sholapur.

Seconder: Dr. A. V. Baliga, Bombay.

#### 11th Meeting:

##### 1. Treatment of Elephantiasis and Lymph Oedema—

Opener: V. P. Mehta, Bombay.

Seconder: T. Kanakaraju,

Ramachandrapuram.

##### 2. Treatment of Hernia with Fascial Grafts and Silk Sutures—

Opener: P. Chatterjee, Calcutta.

Seconder: S. K. Datta, Calcutta.

##### 3. Treatment of the Bone Cavities in Chronic Osteomyelitis—

Opener: D. K. Sabhesan, Vizagapatam.

Seconder: B. N. Sinha, Lucknow.

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## A STANDARD TECHNIQUE FOR RHINOPLASTY\*

By

LT.-COL. B. S. NAT, I.M.S.,  
& Y. V. SACHDEVA.

The repair of nasal defects was being undertaken in India from ancient times. It was made known to European Surgeons in 1794 by a letter which was printed in the Gentleman's Magazine. In this letter a description of the operation, along with the portraits of the patient before and after the operation were given. The first English Surgeon to make practical and successful use of this information was Mr. Joseph Constantine Carpue, Surgeon at a private medical school in London. Since that time a large number of modifications have been carried out by various surgeons from time to time in different countries.

The incidence of cases coming to the hospitals in the Punjab with nasal and upper facial defects is fairly large. In the Mayo Hospital, during the year 1946, fourteen cases were admitted for repair of these defects. The commonest cause in these cases was trauma. The usual motive for inflicting this trauma was to deface the person to take revenge.

There are different methods for repairing the nasal defects. The old Indian method is to take a forehead flap. In the Italian method, a flap is taken from the arm and in the French method the flap is taken from the face on both sides of the nose.

The classic Indian method of rhinoplastic procedure has many advantages over other methods which may be enumerated as follows:—

1. The skin of the forehead when it is transposed over the nose to cover a defect harmonizes very well with the skin of the rest of the face.

2. The abundant blood supply makes it possible to utilize long flaps without any danger of sloughing.
3. As the forehead is in such close proximity to the nose, the operative procedure is simple and does not require any cumbersome immobilising devices.
4. A fair amount of tissue is available from the forehead to cover most of the nasal defects which cannot be taken from the face without disfiguring it seriously.

The only objection to the use of the forehead flap has been the resulting secondary deformity in the form of scars over the forehead which, however, can be overcome by using a median flap.

After the 1914-1918 War the importance of lining the flap was understood by the surgeons, as well as the value of giving some stiffening device. The lining to the flap was provided by applying a Thiersch's flap on dental composition to the forehead flap. Thiersch lining unless particularly thick does not persist all round and marked scarring and distortion occurs. There is also really no control over the shape in these Thiersch lined flaps.

The other method of lining the flap is the use of two pedicle grafts one lining the other, the defect in these double pedicle grafts being that they become bulky and cannot be shaped properly.

The method of folding the flap which is described in this article as the standard

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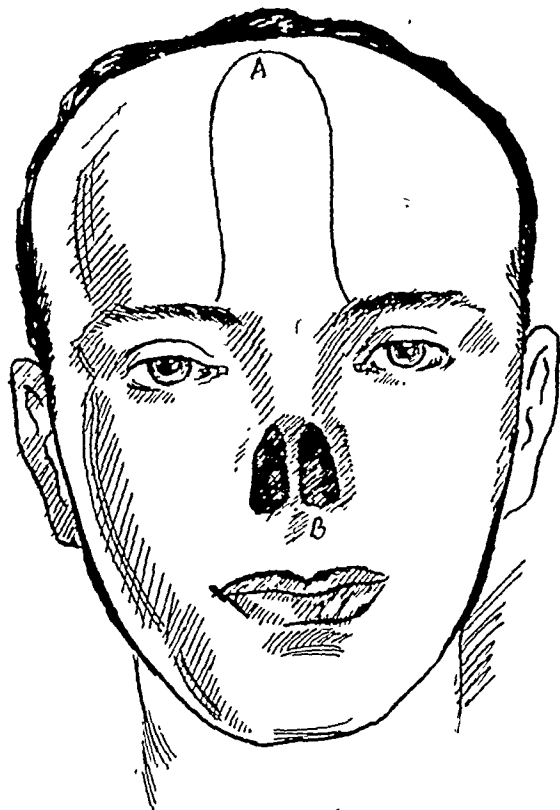


Fig. 1.  
Illustrates the nasal defect and the  
outline of the forehead flap.

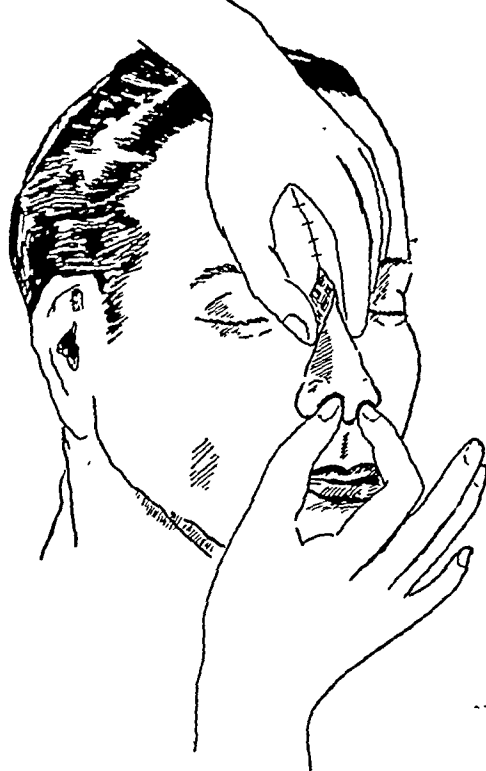


Fig. 2.  
Illustrates the folding in of the flap  
to form nostrils and septum of the  
nose.

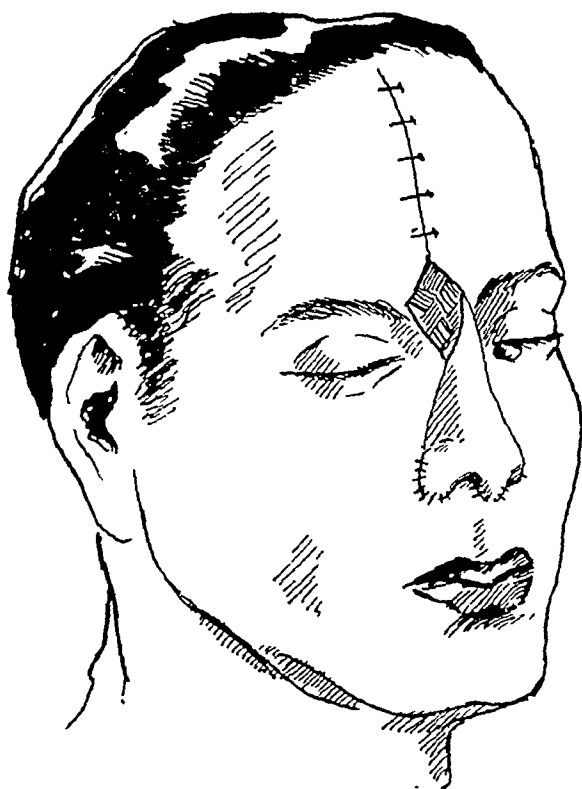


Fig. 3.  
Shows the stitching after the folding  
the flap.

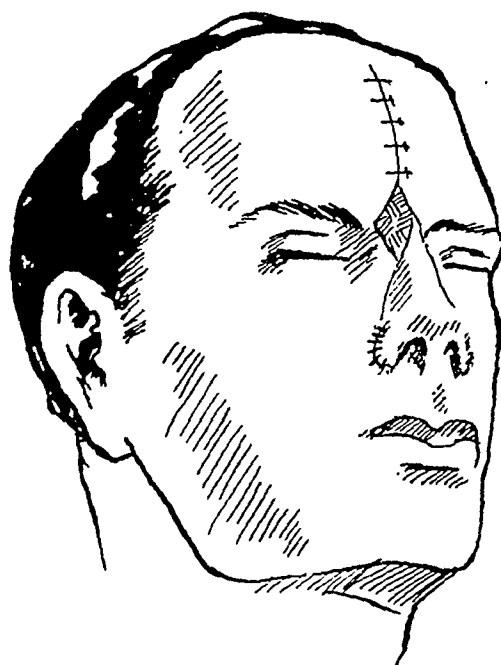


Fig. 4.  
Another view showing the stitching  
of the newly formed nose.

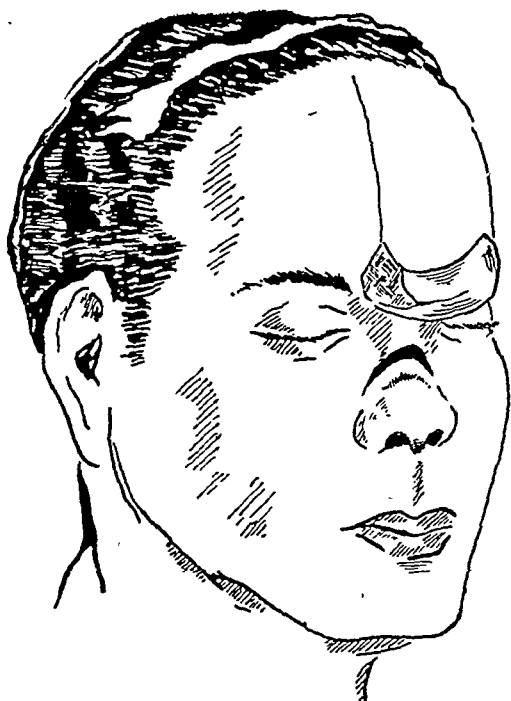


Fig. 5.

The upper part of the flap is divided  
and turned up.



Fig. 6.

The upper part of the nasal defect  
is stitched and also the upper portion  
of the flap is returned back and  
stitched.

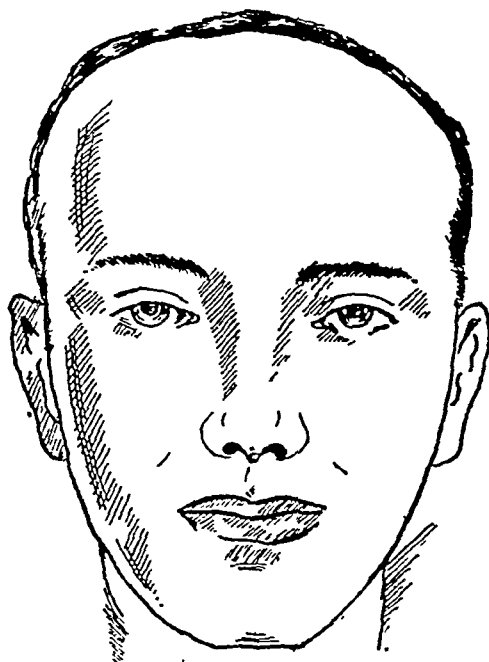


Fig. 7.  
Final Results.

method for repairing nasal defects is superior to other methods as it gives the operator a very considerable latitude in shaping the nose and also an excellent healthy and durable lining which is not subject to any distortion or contracture

One of the authors came to know of this method from an officer in charge of a plastic unit. This method has since been illustrated in Hamilton Bailey's Surgery of Modern Warfare without any detailed description.

This method as originally practised by us depends upon a curved forehead flap with its base near the glabella and this flap left a fairly big granulating area which even if it was grafted left a scar on the forehead as can be seen faintly in Figs. 8 and 9.



Fig. 8.

This method of making the flap was given up and we started using the median vertical flap. The gap left by the latter flap could be stitched into a linear vertical scar.

The technique consists of making two parallel incisions over the forehead, extending from just above the frontal eminence to the hair line on both sides. The width of the flap so marked depends upon the nasal

defect. This flap is raised from its bed and when it reaches the region of the eye brows, blunt dissection is carried downwards almost to the root of the nose, thus saving the frontal vessels from injury.

The flap is then employed as a means of supplying tissue to repair the defect of the nose. The details of the repair are described subsequently.

The defect of the forehead is closed immediately by approximating the edges of the forehead wound. The resulting vertical scar in the centre of the forehead is a surprisingly inconspicuous line. There is, of course, an upper limit to the size of the flap otherwise hair bearing area is included in the flap. The size of the forehead and the



Fig. 9.

degree of elasticity of the skin also have a bearing on the use of this method. Patients with low hair line do not supply much tissue for repair of large defects. In these cases the former methods of taking curved forehead flap can be used with advantage.

Large gaps may be closed with approximation of the borders by the following methods:—

1. In small gaps about half an inch wide, there is no difficulty in bringing the edges together with a median suture line; after the forehead tissues have been undermined on either side of the gap. We stitch the scalp in two layers as it gives much better scar and controls hæmorrhage.
2. If the forehead defect covers an area larger than half an inch, the skin is freely undermined on each side of the raw area. Then one or two incisions are made on the deep surface of the undermined skin, parallel to the incised edges, through the galea but not penetrating all the subcutaneous tissue or any of the skin. This procedure will tend to loosen the skin of the forehead and will allow the approximation of the borders of the wound without undue tension.
3. In more extensive gaps the approximation is brought about by (a) undermining freely, (b) vertical cuts through the frontal fascia and (c) by a horizontal incision just above each eyebrow which allows the shifting of the skin towards median line without distortion of the eyebrows.

The free end of the flap is brought to the nasal defect. The flap is steadied by grasping it about its middle between the index finger and the thumb of the left hand. With the left hand steadying the flap, the right thumb and index finger pinch up a vertical fold of skin about the middle of the free end of the flap. The raising of this fold will produce two depressions (the future nostrils) on either side of it. In this way a double layer septum is formed and by pushing in, the alæ are also lined by skin from inside. This is illustrated in Fig. II. This gives a normal shape to the nose forming the alæ and the septum. The shape can be altered by the amount of folding in to suit the nasal defect. Thereafter the edges of the nasal defect are freshened by paring its margins. Having controlled the bleeding the stitching of the flap to raw area is started. The tip

of the flap (a) is stitched to the septum at (b). The stitching must start from the septal end and proceed towards the alæ never in the opposite direction. The outer



Fig. 10.

stitches are applied as seen in Fig. III & IV. A few mattress sutures to the septum, alæ and tip of the nose are helpful as they prevent hæmatoma formation in these regions. Any skeletal stiffening that may be found necessary is grafted at a later stage. With this method it is seldom necessary.

The standard method has the following advantages:—

- (i) It is simpler.
- (ii) It can fill most of the types of nasal defects.
- (iii) The number of operations is reduced to two.
- (iv) The patient can leave the hospital in about six weeks.
- (v) The æsthetic results are definitely superior to other methods.



Fig. 11.



Fig. 12.



Fig. 13.

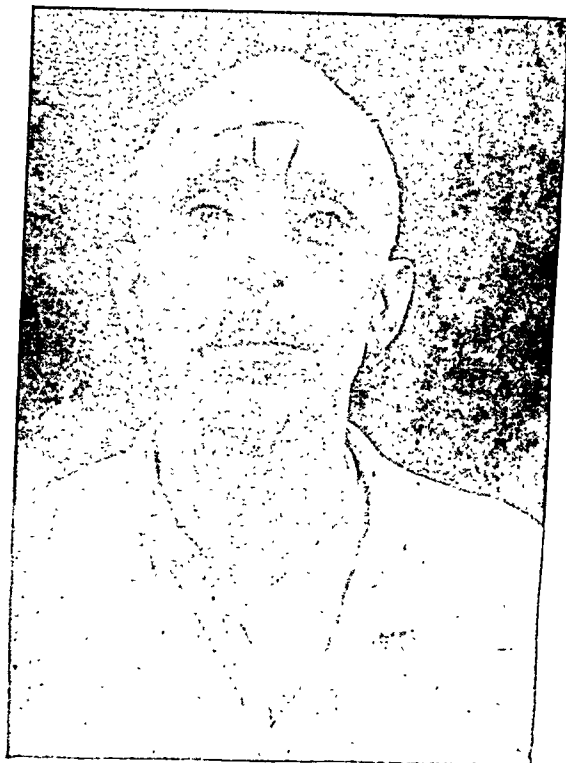


Fig. 14.

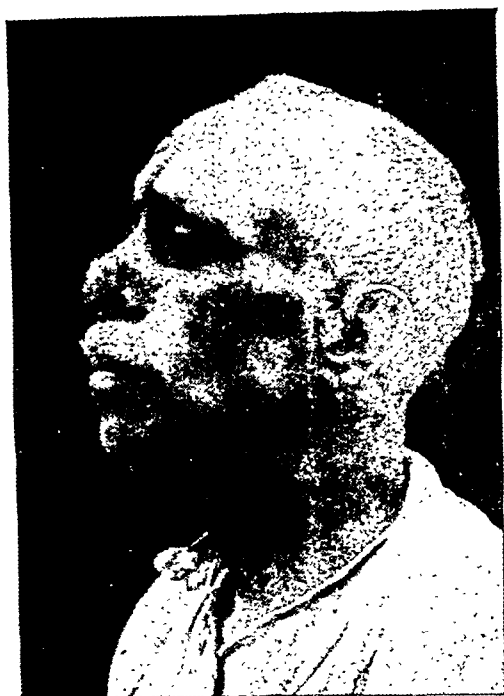


Fig. 15.

The following cases are being given because each demonstrates a minor variation of the technique here described:—

**Case No. 1.** F.M. aged 33 years. The patient had his nose cut off by enemies. Figs. 8 & 9.

May 2, 1946, operation was performed under endotracheal ether anaesthesia. A horizontal flap was taken from the forehead. The flap was  $1\frac{1}{2}$ " wide with its pedicle on the left side. The free end of the flap was brought down and was folded and stitched according to the technique described above.

June 10, 1946, 2nd Stage. The anaesthesia was the same as in first operation. The flap was cut and after shaping it, it was stitched to the upper part of the nasal defect. The rest of the flap was stitched back. The granulating area took a long time to heal.

**Case No. 2.** N.R. aged 40 years. The nasal defect was traumatic in nature and was extensive Figs. 10 & 11.

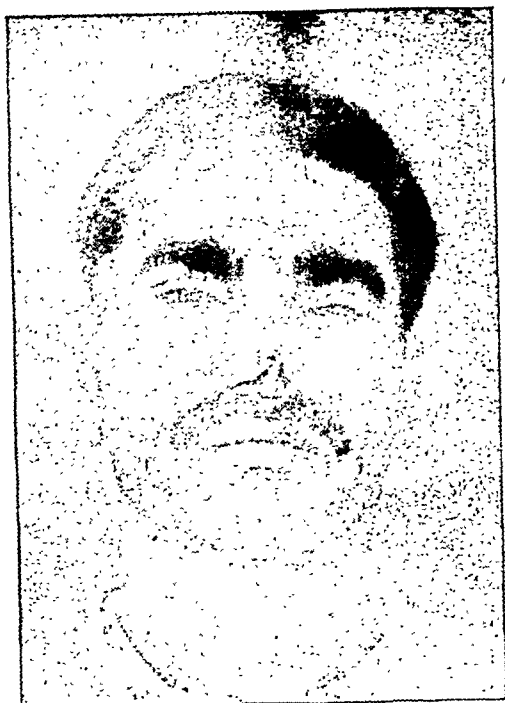


Fig. 16.

October 11, 1946, operation was performed under endotracheal ether anaesthesia. In this case a median vertical flap  $1\frac{1}{2}$ " wide was taken. The flap was twisted and brought down to the nasal defect. This was stitched after folding according to standard technique described above. The forehead defect was also closed after freely undermining on each side and making two incisions under the undermined skin, through the fascia but not penetrating all the subcutaneous tissues. Even this was not enough and a horizontal cut was made just above each eyebrow which allowed the shifting of the skin towards median line without distortion of the eyebrows. The stitching of the scalp was done in two layers.

November 4, 1946, 2nd Stage.

The flap was cut and stitched to the upper nasal defect after freshening the edges. The upper part of the flap was taken back and stitched to the raw area.

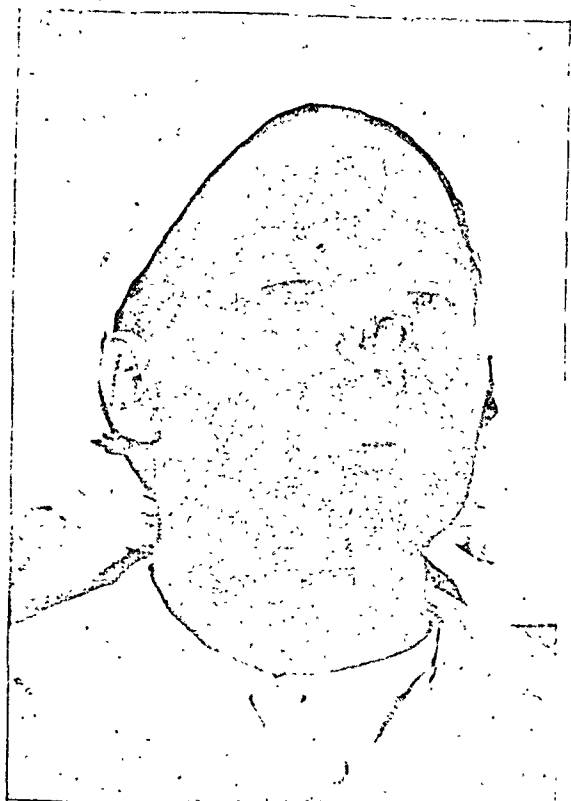


Fig. 28.



Fig. 29



Fig. 30.



Fig. 31.

# A STANDARD TECHNIQUE FOR RHINOPLASTY

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The proximal part of the flap was stitched back in the forehead defect.

Figs. 29 & 30 show the final result.

Case No. 7. A.B. aged 25. This case had very extensive nasal deformity with scars on right cheek. The upper lip was also defective due to the same trauma. Figs. 32 & 33 show the defect.

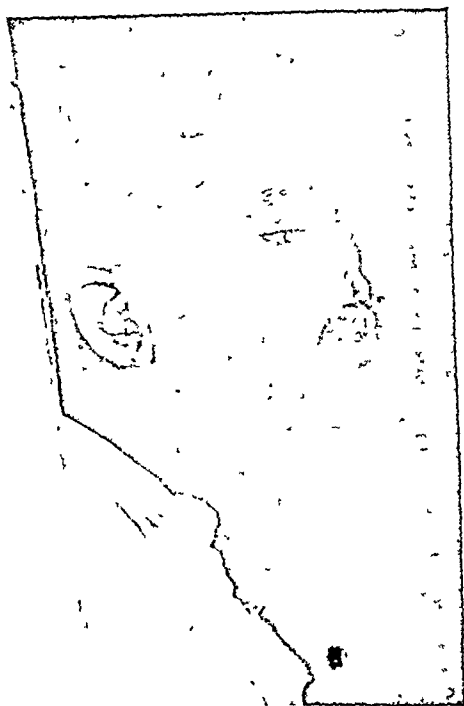


Fig. 32.

1947—Endotracheal ether anaesthesia—vertical flap 1½ inches long was taken from the forehead. The nose was repaired by the standard technique. The gap was closed by relaxing the surrounding skin and making incisions on the cheeks.

1947. Second Stage. The flap was used for the final repair of the nose

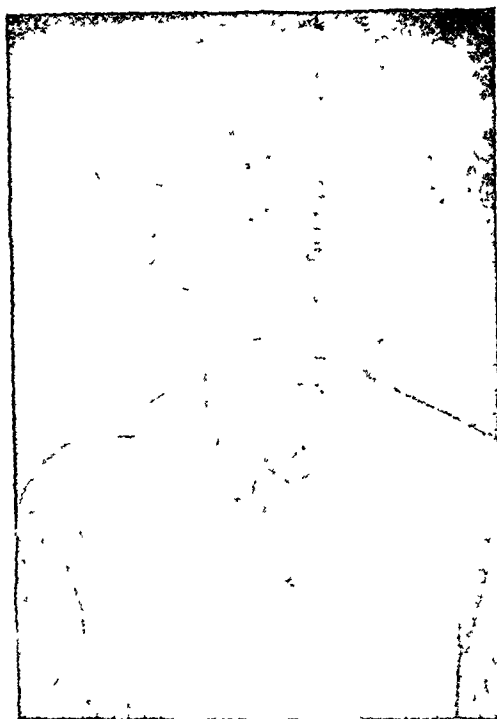


Fig. 33.

done. Fig. 33 shows the repair of the nose after the second stage. The patient is still under treatment. The repair of the lip will be undertaken.

## SUMMARY:

- (1) The repair of the nasal defects by different methods is described.
- (2) The repair by median flap from the forehead is described in detail.
- (3) A technique for the repair of nasal defects by a method of folding the forehead flap is suggested as the standard technique.
- (4) Seven cases of nasal repair are reported with Pre-operative and Post-operative photographs.



# FACE AND PALATE CLEFT

## ANATOMY, EMBRYOLOGY AND TERATOGENESIS

By

G. POLITZER.

Hardly any other malformation is so well known to the public as harelip and cleft palate. The ugly deformation of the face and the severe impediment of speech have early drawn the attention of the laity and surgeons alike to these abnormalities. This is witnessed by the fact that popular names exist for both (*harelip—Hasenscharte-bec-de-lievre, Wolfsrachen—gueule - de - loup*). Public interest is focused on these malformations also for two more reasons: their frequent occurrence and their apparent heredity: *Davis* estimates, that 1% of all children of the white race are affected by one of these deformities and *Conway* corrects this figure even to 1.4%. Amidst all the malformations found in newborns, 5.5% are harelips or cleft palates (*Conway*). As to the heredity of these deformities it suffices to quote *Davis* who found facts pointing to heredity in 57% of the cases, although the interrogation of the relatives was conducted on very simple and expedient lines only.

My own interest was drawn to these malformations at various times of my scientific career. It was first the so-called median lipcleft (not "median harelip") the origin of which I was able to clarify in two subsequent embryological investigations (1926, 1930). Then I occupied myself with the oblique facecleft and the embryology of the processes and furrows of the embryonic face (1936 a & b) and arrived at new results and hypotheses. I shall deal with these researches at the end of this paper; these findings however are hardly of surgical importance in view of the great rarity of these malformations, *vide* for instances *Davis* who, amidst 427 harelips and cleft palates found 2 median lipclefts only. These papers led to my personal acquaintance with *V. Veau* who together with *v. Langenbeck* and "push back" *Dorrance* have contributed most to the surgical treat-

ment of these malformations. It was together with *V. Veau* that I wrote a booklet on the primary palate and the genesis of the harelip. Unfinished are my studies of the cleft palate. The material I have collected lies in the Embryological Institute of Vienna the director of which I was before my leaving for India. Some results I got published by my pupil *Pons-Tortella*, besides there appeared a good and exhaustive paper on the development of the secondary palate in man by the retired professor of anatomy of Vienna, *F. Hochstetter* but being void of clinical knowledge he did not extend his researches on the clinical aspects of the embryological findings.

Let us first discuss the question of the nomenclature: It was the merit of *Geoffroy de St. Hilaire* to have introduced scientific methods into investigation and classification of the monsters and malformations, which before were the hunting ground of superstition and folklore. But the merit goes in the first instance to *G. Schwalbe* and to his successor *G. Gruber* who in their handbook of Teratology gave the scientific world the first systematical description of all the malformations in existence. They used especially Greek words for the denomination as no other language is so flexible to the formation of impressive and all-comprising nouns. The terms used by the German authors are thus *Cheiloschisis* for the lipcleft, *Gnathoschisis* for the jawcleft and *Palatoschisis* or—linguistically more correct—*Uranoschisis* for the palatecleft. Lipcleft, Jawcleft and Palatecleft are the most suitable names to be used in English. The Greek names combine well with each other for instance, *Cheilo-gnathoschisis* or *Cheilo-gnatho-urano-schisis*. In English Lip-jaw-palate-cleft does not sound well, but it is still preferable to other attempts. So for

instance *Ritchie's* "prealveolar, alveolar and postalveolar clefts" are most unsuitable, as gnathoschisis is not a cleft of the alveolus, but of the alveolar process of the maxilla. As to the anatomy of these malformations, I like to draw attention to some essential facts which, less known than the general aspects of these deformities, are of striking importance for the embryological explanation of the origin and formation of these anomalies.

1. Harelips are usually divided into two types, cases, in which the anomaly is restricted to lips only (simple harelip, lipcleft, cheiloschisis) and cases in which the alveolar process is involved too (compound harelip, lip-jawcleft, cheilo-gnathoschisis). German authors distinguish 3 degrees of lipclefts: Ist: There is only a notch, IIrd: The lip is divided, but the cleft does not reach the nares. IIIrd: The nares are included. Another form of harelip was described by *Veau*: The *harelip with bridge*. There are anterior and posterior bridges. The anterior bridge connects the margins of the lipcleft. These bridges are often to be seen in newborns, but they are usually torn later on, either already by the manipulations during the delivery or by muscular action during the sucking of the infant. Often the bridge is already torn, but its course can still be reconstructed from small protuberances on both margins pointing to the former insertions of the bridge.

2. It is known since long that the combination forms of harelip and cleft palate are so frequent, that according to the calculus of probability a causal nexus for the simultaneous occurrence of both malformations must be stipulated. Recent investigations have shown, that this coincidence is even more frequent than formerly expected. *Broderick* (quoted after *Wardill*) found jaw-clefts in cases of simple harelips by X-ray examination. *Wardill* describes a "Mongolian face", i.e. a typical broadening of the face combined with flatness of the prominent features in cleft-palates, in which cases the lip was "closed". If we consider the congenital absence (agenesia) of the lateral incisors as an anomaly of the same ilk (what

is surely correct from the embryological point of view), the number of cases in which the simple harelip affects the jaws is still greater. This leads to the conclusion that there must be a genetic or embryological factor which accounts for the frequency of combinations of lip, jaw and palate-clefts.

3. The palate clefts are characterized by great individual variations. Often the cleft is unilateral, i.e. the mouth cavity communicates with one nasal cavity only, while the vomer is in connection with the palatine process of the opposite side. In other cases the "cleft is changing from one side to the other". It means, that an incomplete anterior unilateral cleft of one side combines with an incomplete posterior unilateral cleft of the other side to form a most irregular bilateral cleft-palate. But even in other cases of more regular nature we are confronted with striking asymmetries in mass and position, which apart from their embryological interest are still increasing the difficulties of the surgeon to operate successfully on these malformations.

4. Especially of interest are typical "hypertrophies" of some bones connected with these malformations. In the unilateral jaw-cleft the maxilla connected with the intermaxillary bone stands in front of the maxilla of the deformed side. In the bilateral cases the intermaxillary bone forms a tumourlike protuberance, bulging forwards between the lip-jaw-clefts. These deformities are indicative of the growing tendencies of the various bones of the face which are displayed freely, if they are not kept at bay by the presence of sutures.

5. There are strange tunnels through the lips in cases of lip-cleft as well as in cases where the lip seems to be normal. For their formation no explanation has been given so far.

6. There are marked differences about the exact spot through which the cleft is cutting. In other words: Hardly any harelip is completely identical with another. But the most striking variations concern the tooth formula. In cases of jaw-clefts 4 different alternatives have been realized: The lateral

incisor lies in the intermaxillary bone (better in the medial margin of the cleft) or in the maxilla (better in the lateral margin of the cleft) or in either of them or in none.

7. In spite of the severe disturbance of lip, jaw and palate the other parts of the face are rather normal. There is for instance hardly a greater occurrence of iris-colobomata in harelips and cleft-palates than in normal cases. This is a striking difference against the conditions in median lip clefts, which are often combined with defects of the nasal septum, abnormally near juxtaposition of the eyes (prosopphthalmia) and absence of the olfactory centres of the brain (arhinencephaly).

All these facts are of the greatest importance not only for the formal genesis of the above malformations, but for the surgical technique also. The great variations in existence call for a special ability of the surgeon to modify the typical steps of the operation: The cutting of flaps after *Langenbeck*, the sutures of *Veau*, the "push back" operation of *Dorrance* in accordance with the special requirements of the case in question and often these modifications cannot be devised before the operation as some details of minor extent but major importance present themselves only during the operation. But there is another reason, why the success of this operation some 30 years ago was decidedly inferior to the results obtained by good surgeons to-day. It cost decades to learn by experience that removal of prominent bone parts should be avoided by all means and technical devices have been published how to turn and to push them into their proper level. Another essential aspect is the physiognomy of the patient. Often corrections of the jaw are essential in harelips cutting through the soft tissue only, to close not only the cleft, but to modify the face according to the normal features of the race concerned. But the greatest progress has been obtained by the acknowledgment of the importance of the "loosening of the soft palate", even in cases, in which it did not form part of the cleft. It is only since then, that patients did not only gain a normal face and a closure of the

mouth-nose-communication, but the anatomical conditions for a normal speech too.

## II. The formation of the harelip.

The formation of the harelip is closely connected with the normal development of the primary palate. In embryos of 5 mm. length (fig. 1) both sides of the embryonic

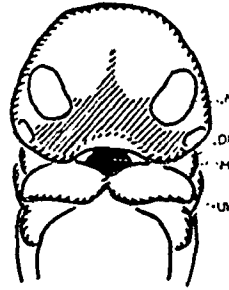


Fig. 1.

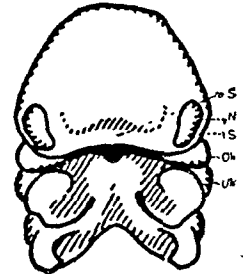


Fig. 2.

Fig. 1.

Model of a human embryo of 5 mm. length (after Peter); M-mouthcleft; N-nasal placode; OK-maxillary process; UK-mandibular process of the first branchial arch.

Fig. 2.

Model of a human embryo of 6 mm. length (after Peter); Abbreviations as in fig. 1; mS-median nasal; IS-lateral nasal process.

face carry an elliptic area of thickened epithelium, the olfactory (or nasal) placodes. In embryos of 6 mm. length (fig. 2)



Fig. 3.

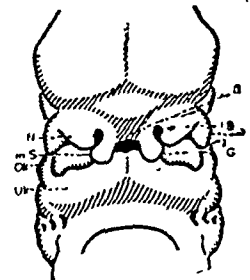


Fig. 4.

Fig. 3.

Explanation in the text.

Fig. 4.

Face of a human embryo of 11.3 mm. length (after C. Rabl); A-eyes; G-primary palatine furrow; II-Incisura interglobularis; IS lateral nasal process; mS medial nasal process (processus globularis); N-nares; OK-maxillary process; T nasolacrimal furrow; UK mandibular process.

these placodes are transformed into the olfactory (or nasal) pits. Now a most interesting process is setting in, which can be understood best by the help of a comparison: Let us suppose, that a zipfastener is sewn into the margins of the olfactory pit. The glider of the zipfastener is at the oralmost point of the margin of the pit (fig. 3). If we are closing now the fastener the pit is transformed into a cavity. The part of the margin of the pit, which remained open is the naris. The floor of the cavity, where the fusion took place, forms the primary palate. In this stage the united margins are marked by an approximately sagittal epithelial plate (the "epithelial wall"). On the surface the primary palate is marked by a furrow, the primary palatine furrow (fig. 4). Fig. 5

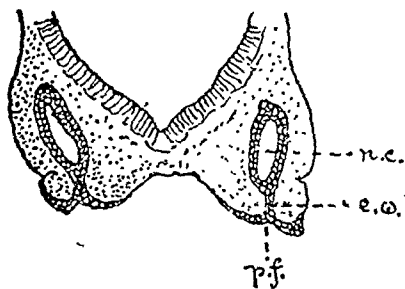
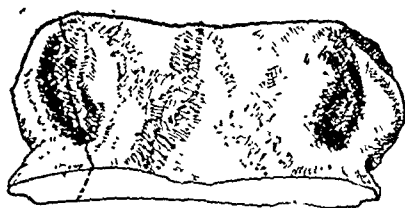


Fig. 5.

Section through a human embryo of 8 mm length; c.v. epithelial wall; n.e. nasal cavity; p.f. primary palatine furrow.

shows a section through an embryo of 10 mm length, in which the epithelial wall is well visible. Fig. 6 represents the model of the face of an embryo of 8 mm. length, which is cut open along the primary palate. The further fate of the palate is characterized



by two main features: The dorsalmost part of the wall is thinned to a membrane (the bucco-nasal membrane) which ruptures. In this way the primary choana is formed. Then the epithelial wall is grown through by connective tissue and the formation of the primary palate is thus achieved (fig. 7 and 8, representing models of embryos of 10 and 11½ mm length).

The classical hypothesis of the formation of the harelip stipulates, that this fusion of the margins of the nasal pits normally taking place in embryos of 8-10 mm length does not happen or does not happen in its entire length. In the first case a lip-jaw-cleft, in the second a simple lip-cleft results. This hypothesis does not cope well with some essential facts.

1. The classical hypothesis stipulates, that the harelips are already formed in embryos of 8-10 mm length. An irregular cleft in the face of so young an embryo can hardly leave unaffected the rest of the face. We would expect malformations of the organs nearby, while in reality these remain astonishingly normal. It is true that *Triepel* has shown a high degree of self differentiation in the tissues of young human embryos, but that concerns the histological differentiation only and does not consider the fact, that any discontinuity of the embryonic tissues at so early a stage must lead to most severe displacements and thus to most remarkable asymmetries.

2. Let us return once more to our comparison of the zip-fastener. It is probable, that if the closure of the margins is imperfect, most often the distal i.e. anterior end of it should be affected. This means, that

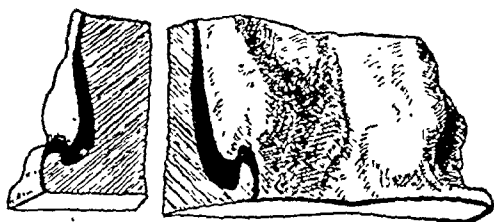


Fig. 6.

Model of a human embryo of 8 mm. length representing the nasal pits. Below: it is cut through the nasal pits to show the thickness of the epithelium.



Fig. 7.

Model of a human embryo of 10 mm. length representing the nasal cavities. The epithelial wall is well visible. The thinned part of it is the bucconasal membrane. Its rupture will create the primary choana.

in mildest cases of harelip the nares should just extend a bit into the upper lip, a malformation, that to my knowledge nobody has witnessed so far. On the other hand the slight notches in the margin of the upper lip, which we see so often as the lightest manifestation of this malformation would mean, that the fusion of the margins was just interrupted somewhere in the mid, a presumption not carrying great probability.

could explain better these malformations. We found soon hints in the work of *Fleischmann* and his pupils. *Fleischmann* opines, that the harelip results from complete or partial persistence of the epithelial wall, which later on separates into the epithelial covers of the margins of the cleft resulting from the dissolution of the epithelial wall. It is clear, that with this presumption bridges and fistulæ and every localisation of the

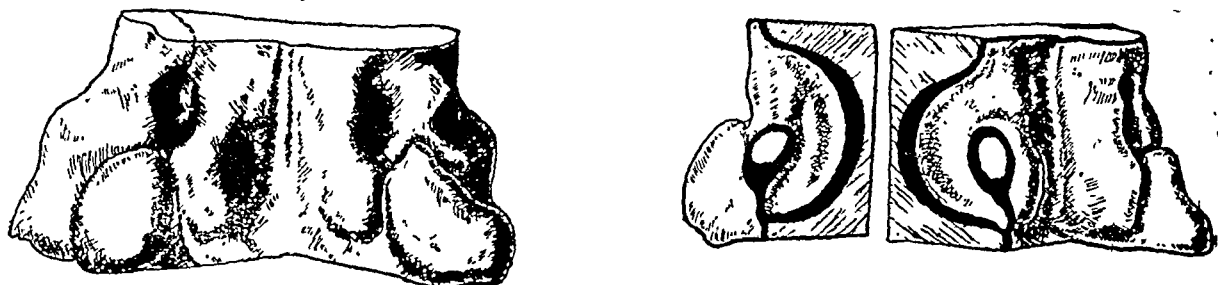


Fig. 8.

Model of a human embryo of 11.5 mm. length representing the nasal cavities. The bucconasal membrane is still extant. Connective tissue has grown through the epithelial wall.

3. But we are facing still greater difficulties, if we try to explain the harelips with bridges. In these cases we must presume, that a fusion took place in the mid of the course of the margins only, while distal and proximal to it the nasal pit remained patent.

4. Also the cases of labial fistula with or without harelip are hardly to be explained. We would have to postulate, that in a most restricted area no fusion took place and that this hole was stretched later on to form a canal as observed in these cases.

In view of all these difficulties *Veau* and I looked around for a hypothesis, which

cleft can be explained. Let us first discuss, if persistence of the epithelial wall will lead to a cleft at all. It is astonishing, that epithelial formations are often believed to afford a solidification of the tissue. Epithelia may do that by the way of transfer of their cells into horn cells (cornification), they may form a cuticula like the ectoskeleton of the crustaceae, they finally, if we like to consider the chordacells as epithelial cells, may lead to an axial skeleton by pressing epithelial cells into a sheath, which can not be overextended. In the latter case the same effect can be produced by liquids even, as in the erection of the penis and is no characteristic of epithelial cells. Cornification and

cuticula-formation are directly visible and can thus be excluded or ascertained in each and every case. On the other hand the central cells of epithelial plates and cylinders show typical degenerations and we can furnish a few good examples for this process from several parts of the human body: The external auditory meatus is closed by epithelial cells for several months. Then the central cells degenerate and the meatus becomes hollow. The same happens with the epithelial stopper which obturates the human naris. Epithelial plates, which cleave into epithelial layers are the lidplate, which closes temporarily the eyelids, the tympanic plate, which forms the inner end of the external auditory meatus and the urethral plate, which cuts into the clitoris. Thus it is most probable that an epithelial wall like that occurring during the formation of the primary palate is bound to separate into epithelial layers, if the plate happens to persist as an anomaly. This hypothesis of the abnormal persistence of the epithelial wall with subsequent cleavage explains easily all cases of harelips and similar malformations.

1. If the wall persists as a whole, its later cleavage results in the occurrence of a lip-jaw-cleft.

2. If it persists in its posterior part, a jaw-cleft, if it persists in its anterior part, a lip-cleft will result.

3. If the connective tissue substitutes a small part of the wall only, bridges of various localisations will result.

4. If there are epithelial remainders left here or there they may give rise to the appearance of fistulae.

We may produce even some support for this hypothesis from the direct observation of harelips in embryos. All in all we could examine 3 of them, their length amounting to 21, 22, 23 mm. resp. In all of them parts of the epithelial wall were still in existence, while in other parts the epithelial wall has been already separated into the epithelial covers of the margins of the harelip. Surely theoretically these pictures could be read also as an attempted fusion of the margins of a harelip tending to a kind of self cure or more scientifically post generative closure of

a cleft of formally bigger extension. In fact this attempt of an explanation has been made by *Maurer*, but I do not think, it carries with it much probability.

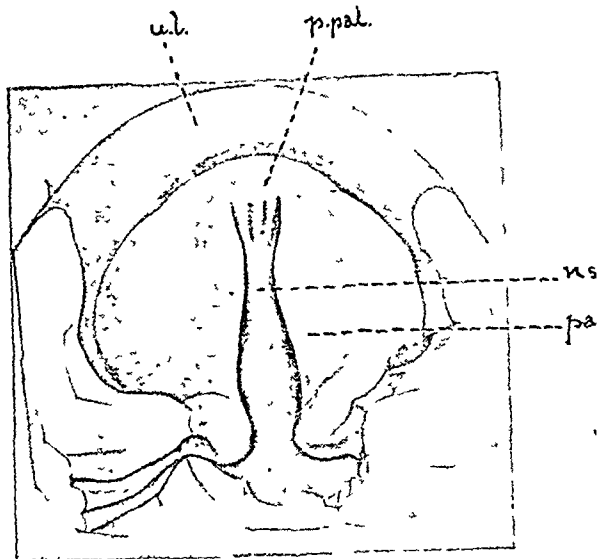


Fig. 9.

The palate of a human embryo of 25 mm. length (after Hochstetter) n.s. nasal septum; pal.p. palatine processes; p.pal. primary palate; u.l. upper lip.

It may be of interest to discuss the forces, which lead to the process of separation observed in these epithelial membranes. The protrusion of the intermaxillary bone in bilateral lip-jaw-clefts, the marked difference in the growth of the medial and lateral margins of an unilateral lip-jaw-cleft may be conducive to the assumption that the separation is the result of the growing tendencies in the embryonic tissue liberated into their components by the discontinuity of the facial bones. But these growths are all of a later date and it is therefore more probable to attribute to them some later and secondary modifications of the face, but to consider the transformation of the persistent epithelial wall into a lip jaw-cleft as due to the intrinsic separative tendencies in epithelial plates and cylinders.

Concluding it can be said, that harelip results from the anomalous partial or total persistence of the epithelial wall, which

appears as a transitory formation during the normal development of the primary palate. The transformation of the epithelial wall into a cleft is due to the intrinsic necrotic tendencies in epithelial walls and cylinders. The excessive growth of the margins of the harelip are due to the growing tendencies of the bones of the face, which are misdirected due to the interruption of their connections in the area of the cleft. Although themselves hardly causative in the occurrence of harelip, they are able to modify secondarily the aspect of the malformation.

### III. The formation of cleft-palate

The description of the formation of cleft-palate necessitates a short resume of the facts known about the formation of the secondary or definite palate. In Embryos of 25mm length thin tissue plates grow out from the medial side of the alveolar processes (fig. 9). The position of the processes is at first vertical (fig. 10); they

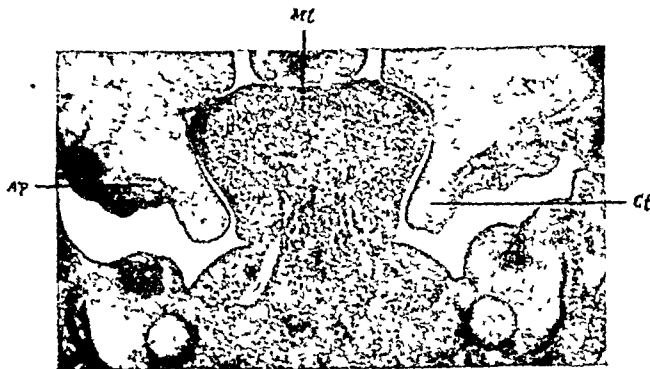


Fig. 10.

Section through the mouth cavity of an embryo of 25 mm. length (after Pons-Tortella). A.p. arteria palatina; G.f. palatine process (vertical); M.t. tongue.

descend on both sides of the tongue. In embryos only slightly older (fig. 11), the palatine processes are horizontal and they are lying above the tongue. Most textbooks contain the old hypothesis of *His*, adopted later by *Peter*, that first one and then the other palatine processes is turned horizontally and that thus, for a short while, asymmetric pictures result, one process being horizontal, the other vertical. *Hochstetter* has proved recently that these

asymmetrical pictures as reproduced by *His*, *Peter* and *Inouye* (and present in 5 of *Hochstetter's* own specimens) are mechanical artefacts resulting from forcible removal of the tongue by damage of the embryo or

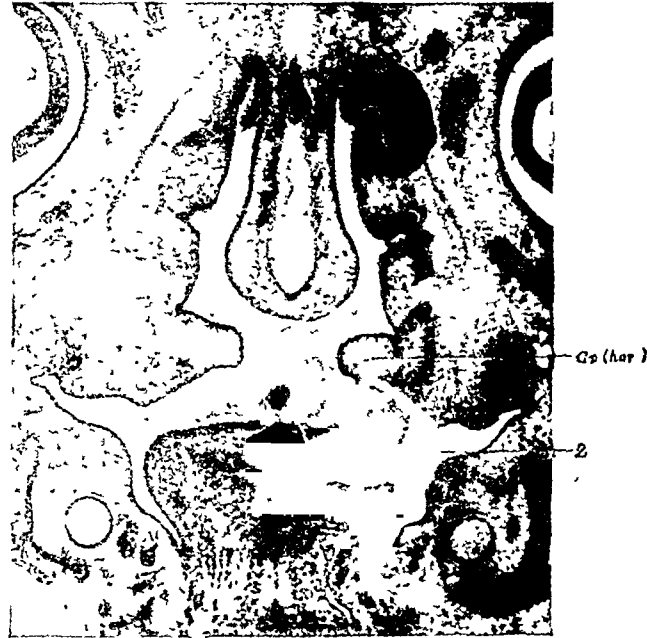


Fig. 11.

Section through the mouth cavity of a human embryo of 27 mm. length (after Pons-Tortella); G.p. palatine processes (horizontal); Z tongue.

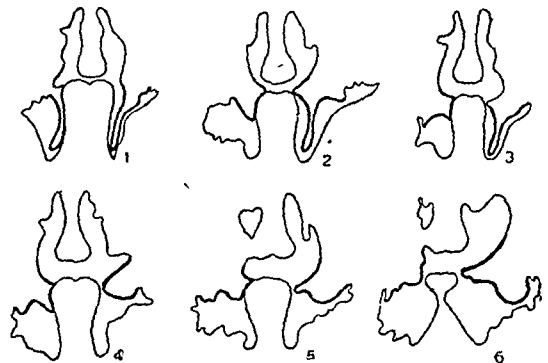


Fig. 12.

Line drawings of sections through the mouth cavity of a human embryo of 26 mm. length (after Pons-Tortella); The palatine processes are partly vertical partly horizontal.

by careless dissection. This mechanism of artificial displacement is also suggested by the observations of my pupil *Pons-Tortella*, that, in enlarged wax-plate reconstructions of tongue and palate of embryos of this age, the tongue cannot be removed downwards but only backwards and that only with considerable force. This makes it probable that the vertical plates are transformed into horizontal ones or that the vertical ones are

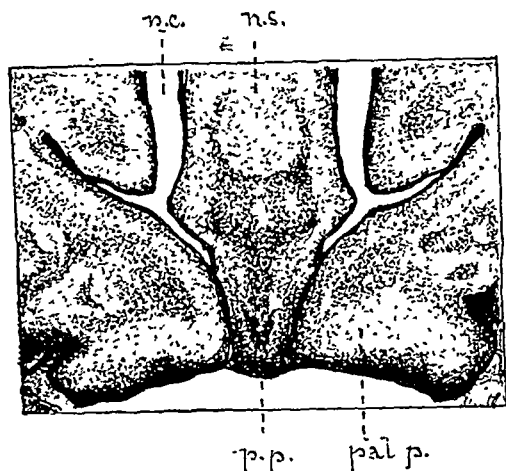


Fig. 13.

Section through the palatine papilla of a human embryo of 30.3 mm. length (after Hochstetter); n.c. nasal cavity; n.s. nasal septum; pal. p. palatine process, p.p. primary palate.

resorbed while the horizontal ones are growing anew. *Pons-Tortella* has reproduced some specimens in which vertical and horizontal palatine processes were present simultaneously (fig. 12). Similar conditions have been described earlier by *Fleischmann* and his pupils in various mammals. These horizontal palatine processes fuse with each other and with the nasal septum, but the way in which they fuse differs in the anterior and posterior parts of the palate. In the anterior part i.e. the area of the intermaxillary bone the primary palate is intercepted between the horizontal palatine processes, the sutures being partly vertical partly horizontal or oblique (fig. 13), while in the posterior part the suture is T-shaped (fig. 14), as the palatine plates fuse with each other and in addition with the nasal septum,

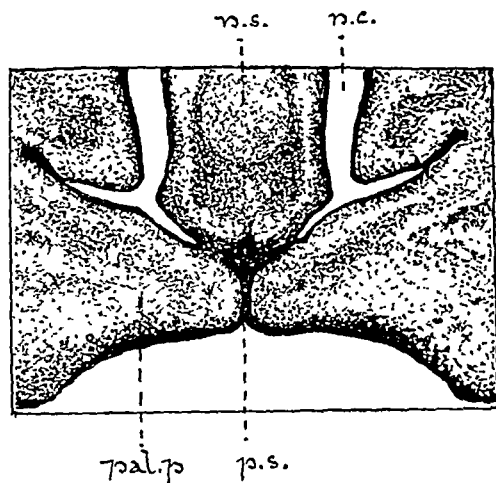


Fig. 14.

Section through the same embryo as fig. 13 only more dorsally; n.c. nasal cavity; n.s. nasal septum; pal. p. palatine process; p.s. palatine suture.

the lower surface of which is the caudal extension of the primary palate. The fusion between the palatine processes starts a bit ventral from their middle and proceeds forwards and backwards. *Hochstetter* as well as *Pons-Tortella*, both in possession of a by far bigger material than any one of their predecessors, point to the great variations in length, fusing time etc. of these processes as well as to the varying fate of the epithelial wall resulting from their fusion. Sometimes these epithelial walls and canals persist for a long while, in other cases, their resorption takes place at an earlier date. It may be remembered, that the persistence of these epithelial walls does not strengthen the sutures as *Peter*, *Rawengel*, *Bergen gruen* are of opinion, but, on the contrary, create a punctum minoris resistentiæ due to the tendency of these epithelial walls to cleave into epithelial covers of the margins of a cleft resulting from partial disintegration of these epithelial formations. This has been discussed already in the previous chapter and needs no further explanation. The fusion of the palatine plates results in the formation of the palate from the palatine papilla up, to the tip of the uvula, while the palatine processes in their non-united parts form the palatine arches.



Complete or partial non-union of these palatine processes are responsible for the formation of cleft-palate.

Although this statement is generally true, it cannot be gain said, that some secondary cleavage of the epithelial suture may result in the extension of a jaw-cleft into the palate and that a cleft-palate of primarily restricted extension may not be lengthened later on by a disintegration of a persistent epithelial palatine suture.

If the palatine process of one side fuses with the nasal septum, while the other does not reach the nasal septum or the palatine process of the opposite side a unilateral cleft-palate results. If both palatine processes and the nasal septum do not fuse, the cleft-palate will be bilateral. Careful measuring has shown that in cleft-palates the constituents of the palate are usually narrower and shorter than normally and that various asymmetries can be ascertained, which make the cases slightly or substantially different from each other.

Special stress shall be laid again on the fact already mentioned in a previous chapter, that combinations of jaw-clefts and palate-clefts are quite often to be recorded and that even in cases in which the jaw-cleft cannot be seen by simple inspection the analysis of the tooth-formula and the X-ray examination of the alveolar process of the maxilla often furnish details proving the existence of a rudimentary cleavage of the jaw too.

In analysing the origin of cleft-palate we have first to remember the extreme variations occurring in this very area. It is clear that abnormal shortness or narrowness of the primordia of the palatine processes must result in their non-fusion and thus in the occurrence of cleft palates. The process of substitution of vertical processes by horizontal ones favours also retardations and anomalies in growth. But the main reason at least in the combined jaw-palate-cleft lies in the existence of a compound harelip. This prepalatal cleft creates conditions which not only are detrimental to or, at least, impede normal growth, but they enlarge the

gap the palatine processes have to close, and may thus facilitate the formation of palatine clefts even in cases in which the growth of the palatine processes was normal.

There is no doubt that the later growth of the adjacent bones changes substantially the original picture. Even in post-natal observations these factors could still be traced in moulding and altering the features of the cleft-palate. But these forces of growth can hardly be accused of causing the malformation, but they are quite important in the later modifications of the aspect of these deformities.

Concluding it can be said:

Cleft-palate results from the non-union of the palatine processes. Persistence of the epithelial wall and later disintegration of it may lead to secondary extensions of the malformation. The palate of a uranoschisis is not only interrupted, but its constituents are often below size in length and breadth as well. This is a clear hint to the fact, that the cleft owes its existence to an original hypoplasia of the palatine processes. The occurrence of these hypoplasias and anomalies of position of these processes is expected to happen rather often, as hardly anywhere in the human body variations in form and position are found as often as in the primordia of the palate. Palate-clefts are often associated with jaw-clefts. In these cases the jaw-cleft is to be considered as causative to the occurrence of the palate-cleft as the space to be overbridged by the palatine processes is broadened. The pathological growth of the bones of the face does not cause the cleft-palate (for that it happens too late) but it may modify the palate-clefts in even essential details.

#### IV. The formation of the Oblique face-cleft

Although this malformation has been known since long, it is of by far less importance for the practitioner, as its occurrence is rare and as many of the cases are so monstrous, that an operation is out of the question, even if the child does survive. In nearly all textbooks the formation of this deformity is described as follows: In embryos of 11 mm length (fig. 4) the face shows a most typical

configuration. The slit-like nares continue towards the mouth-cavity as two furrows, the primary palatine furrows, from which the epithelial wall described in an earlier chapter extends towards the depth of the face. From this furrow another furrow branches laterally, the so called naso-lacrymal furrow. The oblique face-cleft is said to result from a non-uniting of this furrow. This opinion is untenable.

1. *Peter* has given it as his opinion, that this furrow is only superficial and does not extend into the depths of the face. He argues that the oblique face-cleft originates from a rupture of the face tissue starting from the depth of the naso-lacrymal furrow. Although he admits the necessity of a rupture he still maintains, that the rupture occurs in the naso-lacrymal furrow.

2. If this were true, the naso-lacrymal furrow should not be able to form a naso-lacrymal duct, besides, if there should be an incomplete oblique face-cleft the naso-lacrymal duct—as far as it exist should follow the direction of the cleft. But *Ask* and *Hoeve* have shown beyond doubt that the cleft crosses the naso-lacrymal duct at various levels, often the duct is lacking, sometimes it lies as a whole on the medial or lateral side of the cleft. A few cases observed by *Ask* and *Hoeve* are reproduced in Fig. 15.

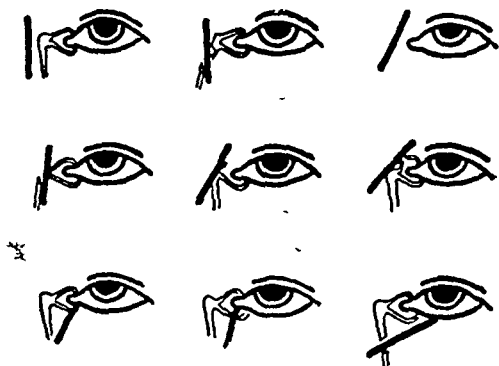


Fig. 15.

The oblique face cleft in its relation to the nasolacrimal system. (9 different cases after *Ask* and *Hoeve*).

3. Although the malformation is rare, *Morian* found, as early as 1887, that we have

to distinguish at least between three various forms of oblique face clefts, which we call since then *Morian I*, *Morian II*, and *Morian III*.

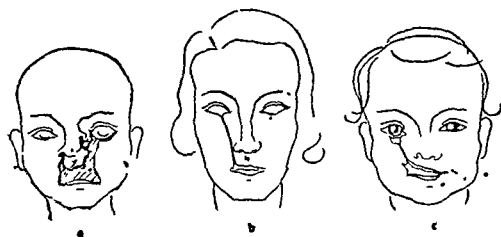


Fig. 16.

Oblique face clefts (*Morian I*, *Morian II* and *Morian III*).

III. (fig. 16). *Morian I* starts as a harelip (Lip-jaw-cleft), but continues into an oblique cleft leading towards the eye and dividing the lower lid. This malformation is often combined with severe defects of the face, which are known as aprosopia. These cases of *Morian I* are therefore characterized by clefts comprising mouth, naris and lower conjunctival recess. *Morian II* is supposed to start from the same point, from which a harelip originates, but it does not lead towards the nose, but direct into the lower lid. *Morian III* branches from the upper lip still further laterally or even from a cross cleft of the face extending the mouth towards the ear. Between *Morian II* and *Morian III* intermediary forms are known. Therefore it is proved that there exists no typical oblique face-cleft, but a series of various deformities collected under this head. For this reason (and for many more as shown by me in 1936) the oblique face-cleft cannot be used for determining the contribution of the embryonic face processes (medial and lateral frontal process, maxillary process) to the features of the face of the adult.

Concluding it can be said: The oblique face-cleft is not a typical malformation. The oblique face-cleft does not show typical relations to the naso-lacrymal duct. There exist no furrow or cleft in the face of embryos, by the persistence of which this malformation could be explained. The malformation is due to a rupture of the face leading through the punctua minoris resistentiae; Mouth, nares,

# OPERATION FOR HARE-LIP WITH REPAIR OF THE FLATTENED NOSTRIL

By

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There is a wide difference of opinion as to the proper age for operating on a case of hare-lip and cleft palate. The majority of surgeons are of opinion that the closure operation should be done by the age of two or two and a half years, which gives the best chances for the child for approximately normal speech. But nowadays many surgeons advocate the operation at a much earlier date.

A cleft in the alveolar process is usually present in such cases along with malposition of the premaxilla. It is important to correct this premaxillary malposition and establish a continuity of the alveolar process while the bony structures are still pliable. If correction is postponed until calcification is complete, the bones cannot be adjusted without fracture or fixation by wire or other foreign material. Up to the age of three months or thereabouts the parts can be moulded and retained in place by lip pressure. Therefore during the period between the ages of three weeks and three months the first operation is done consisting of moulding the premaxilla with the fingers and closing the cleft in the lip. If cleft of the hard and soft palate be present closure of the latter is deferred until eighteen months to two and a half years.

In unilateral hare-lip with cleft palate premaxillary malposition is not usually present to a high degree but the three separate deformities present are (1) Separation of the maxilla with the cleft in the alveolar process, (2) Cleft in the lip and (3) deformity of the nose. The successful repair of hare-lip must overcome the abnormalities mentioned. The cleft in the bone can be disregarded, for there are very few jaw splits which will not close from the pressure of the repaired lip and its constant muscular

play even though the repair is done relatively late.

As regards the repair of the cleft there are certain points which should be kept in mind, viz., the vertical height of the lip on the two sides should be equal. The height should not be too great or an inartistically long upper lip will be present. The vermillion edge must meet smoothly on the same plane. The "mouth line"—junction of the lip when closed—should be smooth without notching or an excess 'blob' at the suture line.

Whatever method of operation is followed the first step is to make an incision beneath the flap on the alar side of the cleft and thoroughly free the tissues beneath the ala from their attachment to the maxilla. This freeing is done by blunt dissection well out into the cheek. Before the paring of the flaps, their dimensions should be measured with calipers, and points marked on the skin with methylene blue by means of a fine hypodermic needle.

Flattening of the nostril is always present in unilateral hare-lip and if left uncorrected after repair of the hare-lip an unsightly deformity persists and the advantages of the operation are to a great extent lost. According to Blair in this deformity of the nostril, the ala has been allowed to retain or return to its abnormal association with the maxilla, whereas normally, the labial attachment of the ala is in close relation with the premaxilla and columella. The change in the direction of the nostril, rather than the real or apparent increase in the width of the floor, is the key to the deformity and means must be taken to correct the rotation of the axis.

Blair's operation consists in thoroughly freeing the spread ala from the maxilla through an incision beneath the lip split-

deformity of the lip may be corrected which is same time.

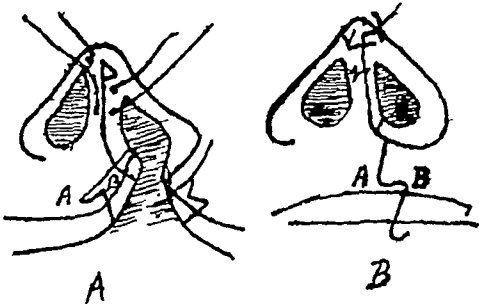


Fig. 1.

Blair's method of Operation for Hare-lip.

ting the columella in the midline, the lower end of the incision extending outward beneath the floor of the nostril, loosening the septal mucous membrane on the affected side, and also the skin over the tip of the nose; rotating all the freed tissues in an inward and forward direction, and suturing them in the corrected position. Secondary



Fig. 3.

Case 1. Fig. 2 & Fig. 3. The patient U.M. female, Aged 11 years, came for unilateral hare-lip with cleft palate and deformity of the left nostril. The method of operation was the one given above as described by Blair. Approximation was done by using interrupted silk tied on the mucous surface, interrupted double horse-hair on the skin surface of the lip and fine silkworm gut on the nostril. The horse hair stitches were removed on the sixth day and the silkworm gut on the ninth. But the silk stitches on the mucous membrane were removed after two weeks. The result was extremely good and the left nostril after the operation appeared as well formed as the right one.

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Fig. 2.

# OSTEOID OSTEOMA\*

By

S. C. MISRA, M. L. SHARMA, & JASWANT SINGH,

**Introduction:**—Osteoid osteoma is a benign form of slow growth. It is a definite pathological and clinical entity. It is frequently overlooked or erroneously diagnosed, the disease being by no means rare. It is often misinterpreted clinically and histopathologically. Probably the disease is more common than a perusal of the subject issued leads one to think. This case is presented not with the idea of contributing any thing new to the subject but mainly to try to popularize further the information already known regarding the disease.

This benign osteogenic tumour evolves in a given site as a proliferation of the local bone forming mesenchyme and particularly of its osteoblasts. It may consist largely of a vascular mesenchymal substratum closely packed with osteoblasts although showing also a scattering of osteoblasts.

**Historical:**—Jaffe was the first to report and describe in detail this benign bone lesion in 1935. Cases with similar clinical manifestations and roentgenological appearances have been reported even before 1935, but with different titles. Thus Hitzrot (1929) reported such a case under the caption "Sclerosing Osteomyelitis", and Bergstrand (1930) reported two cases under the heading "A peculiar and probably not hitherto described osteoblastic disease in long bones of hand and feet". Thoma referred to the condition in 1938. Jaffe and Lichtenstein (1940) reported further about their experiences and by then had collected material from 33 such cases. Hamilton (1945) gave a detailed description of this clinical entity along with case reports, roentgenological diagrams and microscopic pictures.

Hatcher (1945) wrote one article in the 'Annals of Surgery' on the pathogenesis of localised fibrous lesion in the metaphysis of long bones. Recently Sharman (1947) has

mentioned two cases of Osteoid osteoma associated with changes in the adjacent joint.

**Aetiology:**—The disease so far has remained one of unknown aetiology. The case presented below has a definite history of trauma.

**AGE:**—Although no age is exempt, it is most common in patients between 10 and 30 years old.

**SEX:**—From reports so far published males seem to be more affected than females.

**SITE:**—Osteoid osteoma has been noted in nearly all parts of the skeleton except ribs; but its favourite sites are the long bones of the lower extremity.

**Clinical Features:**—The chief clinical complaint is of pain. It is mild and fleeting in the beginning but gradually becomes constant and severe. It is worse with exercise, and most acute at night. It is localised directly over the site of pathology. Occasionally it is referred. The pain antedates roentgenographic changes by weeks and even months. There are no systemic symptoms and signs, nor is there evidence of local inflammation. The appearance of fever and leucocytosis should cast doubt upon the diagnosis.

**Physical Findings:**—Exquisite, rigidly localised tenderness over the exact site of lesion and the ability to localise the trouble accurately is characteristic even in very young patients. If the lesion is superficial, there may be moderate swelling. (In the present case the swelling was spread over a wide area of the bone affected). The swelling is due to congestion oedema of the periosteum. Deformity of the bone may be well marked due to a deposit of sclerotic reactive new bone beneath the periosteum, especially when the lesion is in the shaft cortex of a long bone. The patient may have a limp.

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**Röntgenographic Findings:**—Occasionally the first picture may be negative or the lesion is too minute to be seen even after months from the onset of pain. Typically an Osteoid osteoma reveals an oval or round area upto 1-2 cm. in its greatest diameter. The centre of which presents small areas of rarefaction and condensation. The lesion is usually eccentric and its main portion is radiolucent. The periphery is marked by a ring of dense bone—the narrow zone of rarefaction, condensation, and in turn, just outside of this a zone of rarefaction. The regional bone about the Osteoid osteoma is always hypertrophied. In cancellous bone the surrounding sclerosis is never so marked as that seen when the lesion is at or near the cortex where the hypertrophy may be enough to obscure the nidus.

**Laboratory Findings:**—All tests including W.R., Blood Counts, Urine Analysis, Bacteriologic Cultures have been reported negative as to the nature of the lesion.

**Pathology:**—

**Part of the Bone affected:**—Osteoid osteoma may occur in the cortex just beneath the periosteum, intracortically or in spongy bone. Much greater defensive response to the lesion is made in the form of marked thickening and condensation of the cortex subperiosteally and intramedullarily if the lesion is situated intracortically in the shaft of a long bone than if it is located in cancellous bone.

There is no evidence that this lesion has ever invaded or broken through the periosteum. If incompletely removed it will continue to grow and produce pain as it did before operation.

The lesions do not grow appreciably even over a period of years. But they tend to become increasingly painful and disabling. There is no tendency to spread or recur.

**Pathological Picture:**—There is a background of very vascular fibrous tissues in which giant cells, osteoblasts, osteoclasts are scattered. In this stroma there arises an irregular paget like pattern of trabeculae which are in large part composed of osteoid tissue. Slowly and irregularly the osteoid

tissue calcifies to become bone which is mixed with the osteoid tissue.

If the pathological lesion is near or on the surface of the cortical bone, the periosteum will likely be thickened, oedematous and will show capillary engorgement. The involved portion of the cortex will also be haemorrhagic in appearance. If, on the other hand, the nidus is within the dense shaft cortex, one may find much sclerotic new bone laid down beneath the periosteum, as well as on the medullary side of the bone.

**GROSS APPEARANCE:**—It usually consists of blood stained gritty, friable, cancellous like bone. The cut surface shows reddish brown flecks mixed with pearl grey osteoid. The reddish brown flecks represent the calcified osteoid quite similar to callus, and the pearl grey—the osteoid.

**MICROSCOPICALLY:**—In the centre it consists of much vascular, richly cellular, embryonal type of osteogenic connective tissue representing all elements necessary in the development of membranous bones from the most primitive myxomatous connective tissue cell to fibrous connective tissue cell, and finally to osteoblast in which are islands and trabeculae of osteoid, calcified osteoid and typical ossified bone surrounded by a large number of osteoblasts and not a few osteoclasts. At most at any place in the vascular cellular stroma, one may see osteoblasts and an occasional osteoclast. Osteoclasts if adjacent to calcified osteoid or atypical bone usually lie in little depression called 'Hornship's Bays'.

At the periphery there is more of osteoid and calcified osteoid which is responsible for the sclerotic outer zone. Between this and the sclerotic parent bone the primitive vascular mesenchymal type of connective tissue predominates with its ramifications into the enlarged adjacent interstices of the perifocal sclerosed bone. In this there are no osteoid or calcified osteoid, though osteoblasts are present. This is the precursor of the lesion.

Occasionally a lesion near a joint produces changes in the latter which may result in hypertrophic arthritis.

**Diagnosis:**—The characteristic pain and tenderness as described in symptomatology,

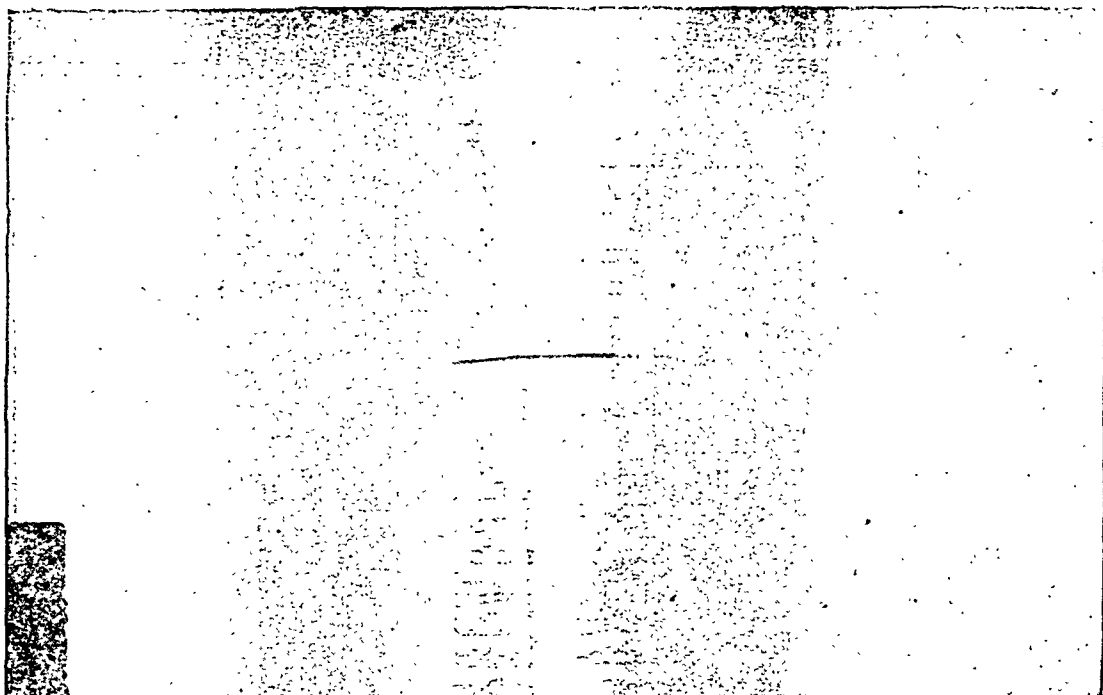


Fig. 1.

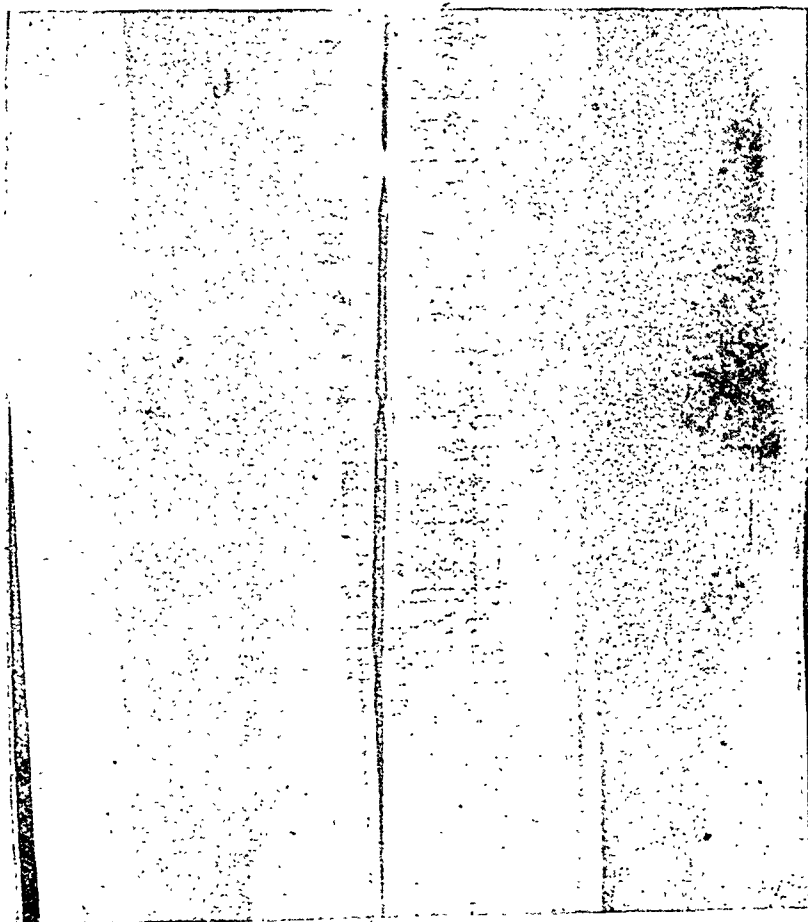


Fig. 2.

bony tumefaction and X-Ray picture give the diagnosis.

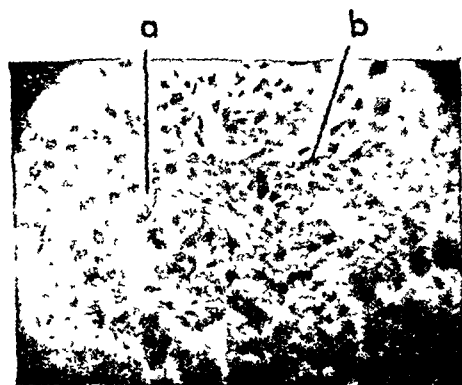
**Differential Diagnosis:**—Osteoid osteoma may be differentiated from:

- (1) Sclerosing non-suppurating osteomyelitis.
- (2) Brodies intercoral bone abscess.
- (3) Osteogenic sarcoma.
- (4) Ewing's endothelial myeloma.

**Prognosis:**—It is uniformly good after complete excision.

**Treatment:**—Surgical excision of the lesion is the treatment of choice.

**CASE REPORT:**—Patient S.K.B., 16 years, was admitted to the Surgical Wards with the complaint of pain and swelling of the left leg of seven months' duration. He gave a history of injury to the leg by a piece of stone 2 years back. He was operated on by somebody else in July '47, under a mistaken diagnosis of Osteomyelitis, a guttering operation was done and the leg encased in plaster. Two months later he again developed pain and swelling at the same site and sought admission.



a—Osteoclast.  
b—Osteoblasts.  
c—Calcified osteoid.

over the anterior border of the tibia was made, gouging of an area 5" x 3" was done and a reddish brown cystic cancellous tissue was seen which was shelled out. Surrounding it, was a clearly defined cavity bounded by dense smooth bone. After thorough scraping the cavity was carbolicised; the wound was closed and a posterior plaster cast was given.

**PATHOLOGICAL DIAGNOSIS:**—Microscopical examinations of several sections of the tissue removed left no doubt about the diagnosis of Osteoid osteoma. The histological characteristics of Osteoid osteoma are very clearly seen in the photomicrographs attached. (Fig. 3.)

#### SUMMARY:—

(1) A typical case of osteoid osteoma of the middle of the left tibia which has assumed a large size due to a previous incomplete operation is reported.

(2) There was definite history of local trauma.

(3) Preponderance of giant cells at certain places may lead to erroneous diagnosis unless sections from various parts of the tumour are carefully examined.

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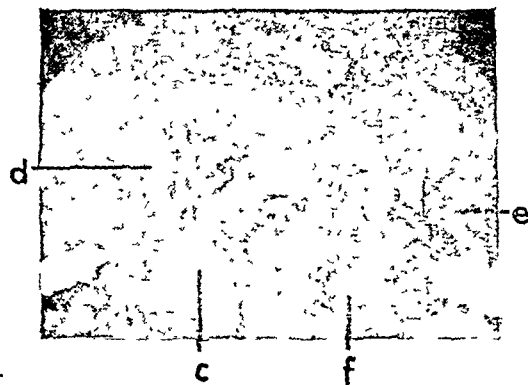


Fig. 3.

d—Vascular osteogenic type of connective tissue.  
e—Osteoid.  
f—Osteoid, lying in a vascular cellular osteogenic mesenchyme.

On examination there was slight wasting of the quadriceps and hamstring. There was a fusiform swelling in the middle third of the leg with two incision scars on the medial side. The tibia was thickened and tender. Blood, Urine and general health normal.

**X-RAY REPORT:**—Marked localised destruction of an oval area in the middle shaft (Figs. 1 & 2). Radiological diagnosis was localised chronic osteomyelitis or Osteoid osteoma.

**TREATMENT:**—The patient was operated on under spinal anaesthesia. A five inch incision

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# PYONEPHROSIS\*

BY

S. P. SRIVASTAVA

The term Pyonephrosis is used to denote the condition where there is obstruction to the flow of urine combined with infection. It may also be termed Pyo-hydronephrosis, the urine of the hydronephrosis sac getting infected and this may be replaced by pure pus, developing from infection and necrosis of the renal tissue.

Pyonephrosis may also be the result of chronic infection of the ascending type in which the process has produced wide infiltration of the pelvis and ureter, thus producing obstruction and back pressure along with the infectious process; the kidney shows the effects of compression with thinning of the cortical substance. There is partial or complete obstruction to the outflow of urine. Usually the obstruction is not complete and so the urine contains large quantities of pus. When complete obstruction occurs there may be no pyuria but the urine may contain pus cells, and co-incidentally the kidney becomes larger and more tender.

The infection in pyonephrosis is usually a mixed one. Coliform bacilli predominate and staphylococcus, streptococcus and *B. Proteus* are often present.

The cause of obstruction is usually a calculus which is small and gives rise to intermittent obstruction at the pelvi-ureteral junction. This leads to hydronephrosis which gets infected, or with the associated Pyelonephritis the obstruction, is superimposed leading on to calculus Pyonephrosis. In the latter case the stone is of large size filling the renal pelvis. Occasionally a stone obstructing one of the major calyces gives rise to Pyonephrosis limited to one part of the kidney.

Rarely a tumour of the kidney or renal pelvis may also give rise to Pyonephrosis.

The mucous membrane of the renal pelvis gets inflamed and ulcerated and the kidney parenchyma is thinned by pressure and necrosis and it may be riddled with abscesses.

The dilatation of the pelvis is not marked to the same extent as in hydronephrosis or pyo-hydronephrosis for the thick inflamed wall of the pelvis resists distension.

The first two cases whose histories are given below were originally cases of hydronephrosis which turned into pyonephrosis.

Both the cases gave a history of a lump in the loin which used to increase or diminish in size off and on; Case No. 1 had the lump for the first time about 4 years ago.

Both the cases started getting temperature about 5 weeks to a month before admission which indicated infection of the hydronephrotic sac.

At the time of admission both were apyrexial except Case No. 2 who had intermittent rise once or twice, which was attributed to reaction after glucose injections.

Both these cases had enormous kidney lumps on the right and left sides of the loin respectively extending from below the diaphragm up to the pelvis and across the middle line. Case No. 2 showed three definite bulgings in the upper portion of the swelling which showed transmitted fluctuation. Such enormous cystic swellings of the right and left kidneys respectively with the previous history of their disappearance following the passage of enormous quantities of urine left no doubt about the diagnosis of Hydronephrosis which might have got infected resulting in pyrexia about a month before admission. There was no other evidence of pus in the two big pyonephrotic sacs except that the patients were weak, slightly emaciated and run down in their health with slight secondary anaemia, there was no tempera-

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ture and the total W.B.C. count did not exceed 8,000 and Polymorph about 75%.

The quantity of pus in both the cases was about 3 pints each and, in one of them, the pus was sterile. Possibly the low W.B.C. count was due to either poor leucocytic response or to the organisms in the pyo-hydronephrotic sacs suffering a natural death and being not the source of toxæmia any more. The two kidney lumps were two closed chronic abscess cavities well walled off.

There was no pyuria, hence the ureter too was completely blocked. The cause of ureteral blockage could not be detected but it was not a calculus.

The risk of primary nephrectomy was undertaken in spite of the low condition of the patients and the reward was a quick convalescence and discharge of the patients within 3 weeks. Subcapsular nephrectomy was the only course possible because of the dense adhesions. Case Nos. 3 and 4 were cases of ureteral calculus lying in the pelvic portion of the ureter giving rise to obstruction and infection in the corresponding kidney. Case No. 3 had no lump in connection with the left kidney. The chief complaint was attacks of colicky pain in the left lumbar and inguinal regions accompanied by fever. Urine culture showed the presence of staphylococci and pyelography revealed loss of function of the left kidney. Plain X-ray of the left pelvis showed a calculus in the terminal portion of the ureter.

The ureter, on exploration, showed a lot of thickening, (being of the size of a thumb) with periureteric fibrosis. On removal of the stone there was a free flow of urine indicating that the left kidney had not totally lost its function. Another excretion pyelogram taken about a month and a half after the uretero-lithotomy showed normal excretion by the left kidney. This was a case of mild infection of the dilated ureter, pelvis and kidney, which cleared up after the relief of obstruction with complete recovery of its function. Case No. 4 is one of Pyonephrosis with a palpable lump in the right lumbar region as a result of obstruction by a ureteral stone lying at the brim of the right side of the pelvis. She used to get fever with rigor and developed secondary anæmia

though the total W.B.C. count in this case too was 8650 and Polymorphs 80%.

The patient left the hospital against medical advice and hence the diagnosis could not be confirmed by operation.

### CASES

**Case No. 1.** D.S., aged 25 years, Hindu, male, complained of a lump on the right side of the abdomen—duration one month. Previous history.—Patient had a similar swelling on the right side of abdomen 4 years back which subsided by itself. One month back the swelling gradually started increasing in size and reached the present size involving the whole of the right side of the abdomen.

The patient was in an extremely weak condition, emaciated and anæmic. There was no rise of temperature, pulse was 78 per minute. On examination there was a cystic swelling, tense, tender and shining, extending from below the right costal margin up to the right iliac-fossa. Fig. 1.

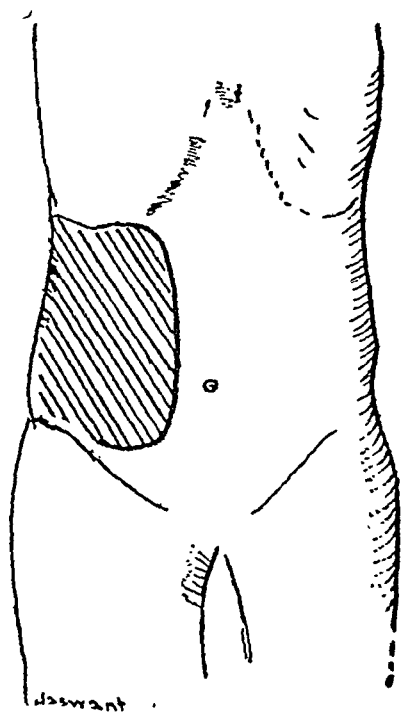


Fig. 1.

Case No. 1.

Pyohydronephrosis of Right Kidney.

**Investigations:—**

1. Total W.B.C.—5800 per cubic mm.

Differential count—Polymorph 76%.

Lymphocytes 22%.

Large Mono 2%.

2. Blood Urea 70 mgm. per 100 cc.

3. Total R.B.C. count—3.5 millions.

Hb.% 10 gm. per 100 cc.

Urine Exam.—Albumen was present.

Few pus cells and stray R.B.C.s.

Plain X-ray—Soft tissue shadow on the right side of the abdomen. No other radio-opaque shadow.

Pyelograph.—There was no excretion by the right kidney—very good excretion by the left kidney with slight hydronephrosis.

**Operation notes:—**

Local anæsthesia. The right kidney was exposed by the lumbo-inguinal incision. After aspirating about 3 pints of pus, primary nephrectomy was done.

Blood transfusion of about 250 cc. of blood was given.

**Exam. of pus:—**

1. Culture was sterile.

2. Microscopic Exam. showed pus cells and necrotic material. He was given local and parenteral penicillin and intravenous glucose and saline for 2 days after the operation.

The wound healed by primary intention within 10 days.

**Case No. 2:—**C.D. aged 40 years Hindu, male, complained of a lump on the left side of abdomen and slight rise of temperature off and on—for the last 15 days.

**Previous history:—**Patient had a similar lump on the left side of the abdomen which used to appear and disappear after the passage of enormous quantities of urine. This trouble had been occurring off and on for the last 8 or 10 years. About 3 weeks ago the patient again developed a lump which was followed by high temperature. The latter gradually

subsided but the lump persisted. The patient was weak, emaciated and slightly anæmic.

The swelling was lobulated and involved the whole of the left side of the abdomen i.e. the epigastric, left hypochondriac and lumbar regions (Fig. 2).

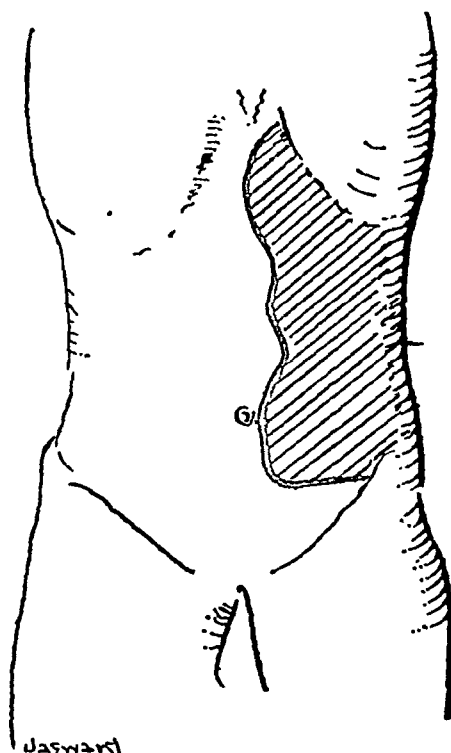


Fig. 2.  
Case No. 2.

**Pyohydronephrosis of Left Kidney.**

1. Plain X-ray—Soft tissue shadow on the left side of abdomen and lumbar region.

2. Pyelography:—Right pyelogram was normal while there was no evidence of excretion on the left side.

3. Blood urea.—53.5 mgm. per 100 cc.

4. Total W.B.C.—5000 per cmm.

Differential count—Polymorph 77%.

Lymphocytes—23%.

Eosinophil—0%.

5. Urine examination—Albumen present. No other abnormality—No R.B.C. or pus cells.

**Operation Notes:—**Operation was done under general anæsthesia and by the lumbo-inguinal incision; the kidney was exposed. After aspiration of about 3 pints of pus, primary nephrectomy was done. About 500

cc. of saline was given by intravenous drip during and after the operation. Recovery was uneventful after delayed shock lasting for 24 hours.

**Case No. 3:**—Patient aged 30 years, Hindu, female, was admitted with the complaint of:—1. Pain in the left lumbar region radiating towards the front of the abdomen.

2. Frequency of micturition.

3. Headache.

The duration of all complaints was 12 days.

The patient got severe pain in the left lumbar region about 12 days ago, and it had been coming off and on in attacks followed by fever. There was frequency of micturition and burning.

On examination there was extreme tenderness on the left side of the abdomen especially in the renal area.

She was weak and ill nourished; temperature and pulse were normal at the time of admission.

**Investigations:**—Urine Exam.—Reaction acid. Albumen present. Sugar, bile, acetone—absent.

**Microscopic examination:**—a large number of pus cells seen.

**Culture:**—Staphylococci grown.

2. Total W.B.C. count 9,250 per cmm. Polymorph-72%. Lymphocytes-16%. Large pons-2%. Eosinophils-2%.

**X-ray of Kidney:**—Plain—No radio-opaque shadow in the kidney and upper portion of ureter.

**Pelvis:**—A large radio-opaque calculus in the left side of the pelvis, possibly at the mouth of the ureter.

**Pyelography:**—No excretion by the left kidney. Excretion on the right side normal.

**Blood urea examination:**—61-mgm. per 100 c.c.

After a course of Cibazol, 20, tablets, the urine became sterile but the frequency of micturition and attacks of pain continued.

**Operation notes.**—Under general anaesthesia the ureteral stone was removed from the terminal end of left ureter which was found to be dilated-up to the size of a thumb, prevesical space and the peri-ureteric region were drained. The wound healed by primary

intention. After one month Pyelography revealed normal function of the left kidney.

**Case No. 4:**—B.O. aged 50 years, Hindu, Female complained of pain in the right hypochondrium for the last 8 months. She used to get fever with rigor and profuse perspiration. She had frequency of micturition and had haematuria once or twice. On palpation a lump was palpable in the right lumbar region of the size of a cricket ball. It was tender and slightly mobile. Rest of the abdomen was normal. She was anæmic and general condition was very much run down.

**Blood:**—Total R.B.C. 2.6 million per cmm.

Total W.B.C.-8,650. per cmm.

Differential count:—Polymorph 80%.

Lymphocytes-15%.

L.M.-2%.

Eosinophil-3%.

**X-ray-Plain:**—A rounded radio-opaque shadow in the region of right ureter where it passes over the right sacrum.

**Pyelogram:**—15 min. & 30 min. after I.V. injection of Uropac:—

Left side excretion was normal. No excretion by the right kidney.

**Diagnosis:**—Pyonephrosis—As the condition of the patient was weak, operation was advised with the help of blood transfusion, but the patient went away against medical advice. This case too is similar to Case No. 3 and here Nephrectomy would have been required while uretrolithotomy would have been useless.

#### Conclusions:—

1. Two cases of infected Hydronephrosis occupying the whole of the right and left sides of the abdomen and pelvis respectively have been described, treated by primary subcapsular nephrectomy.

2. Both these cases had no pyrexia and had a total count not exceeding 6,000 though the total quantity of pus was about 3 pints.

3. Two cases of Pyonephrosis due to ascending infection of the ureter and kidneys caused by ureteral calculus have been described.

4. One of the above cases was treated by uretrolithotomy followed by complete clearance of infection and return of function of the corresponding kidney.

# TECHNIQUE FOR POSITIVE PRESSURE INTRATRACHEAL ANAESTHESIA IN ANIMALS\*

By

R. NIGAM.

It is a well known fact that one of the greatest dangers of intrathoracic operations is the occurrence of pneumothorax as soon as the pleural cavity is opened. This may cause serious respiratory embarrassment and may be fatal. In human beings where the pleural cavities of both sides of the chest do not communicate and are partitioned off from each other by a comparatively steady mediastinum the results of a wide opening of the chest cavity may at times be compatible with life but in the common laboratory animal, e.g. the dog, where the pleural cavities of both sides communicate with each other and the mediastinum is an incomplete and a less resistant partition, a wide opening of the chest is invariably fatal.

There have been various methods of positive pressure anaesthesia in animals described in the literature and are in use particularly in the U.S.A. where experimental surgery has become a very important hand maid to surgery in the human being. Several complicated mechanical aids are available which can inflate and deflate the lungs at a regular time interval.

The development of devices for artificially inflating the lungs with air dates from ancient times. Hippocrates and Paracelsus (1493-1541) William Hunter, Goodwyn (1788), James Curry (1791), Fine of Geneva (1800) and Cap of Lyons (1828) have reported methods of pulmonary inflation. Finally Tuffier, Hallion and Quenu demonstrated the value of artificial inflation of the lung through the larynx for the prevention and relief of surgical pneumothorax (1896). Milton in 1897 operated successfully upon a goat and upon an Egyptian with the use of intratracheal insufflation. Doyen of Rheims designed the

first finished model of an intubating apparatus. Later the Fell O'Dwyer model appeared. This was modified by Matas so that general anaesthesia could be administered with it. In 1896 Parham used the Matas apparatus in the first thoracic operation on record in the U.S.A.

Sauerbruch in 1904 developed the negative pressure cabinet which was used successfully on both animals and human beings in the prevention of pneumothorax. Brauer presented a positive pressure apparatus which was modified and improved by Green and Janeway in 1907. This pressure cabinet was also used postoperatively until adhesions had formed between the visceral and parietal pleura. Meyer in 1910 developed a differential pressure cabinet and later emphasised the necessity of interrupting now and then the pressure, allowing the lungs to collapse. He also advised leaving the patient under differential pressure for some time after the completion of the operation. These differential pressure chambers were very expensive.

Meltzer and Auer perfected and popularized insufflation anaesthesia. They found that if they passed a tube through the larynx of a dog almost to the bifurcation of the trachea and blew an air-ether mixture through this tube in a continuous stream the animal could be kept alive and anaesthetized for many hours, even after all voluntary respiratory movements had been abolished by curare. In these animals it was possible to open both pleural cavities widely and to have the animals remain alive for many hours. The respiratory tract was efficiently protected from aspiration by the continuous outgoing current of air. Chloroform used in this method led to inflammation of the lungs,

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\*From the department of Surgery, Medical College, Lucknow. The author is grateful to Capt. K. S. Nigam, Mr. R. N. Sharma and Mr. Prakash Chandra for their assistance and help.

but ether proved to be a safe and reliable anaesthetic.

Carrel reported very successful experimental operations upon the heart and the aorta using the Meltzer-Auer method of intratracheal insufflation. Elsberg was the first to introduce this type of anaesthesia into clinical surgery after obtaining very satisfactory results in thoracic surgery on dogs. Lillenthal gives a detailed account of the first case of thoracotomy in a human being under anaesthesia by intratracheal insufflation. Most of the later devices for intratracheal anaesthesia in animals are modifications of Auer and Meltzer's original apparatus.

The apparatus to be described in this article is notable for its simplicity of construction and for the gratifying results it has enabled us to obtain. It was developed in our surgical research laboratory at King George's Medical College, Lucknow. It is a positive pressure intratracheal insufflation anaesthesia apparatus embodying the Meltzer-Auer principle.

## APPARATUS

The insufflatory apparatus (Fig. 1) delivers an air ether mixture at a known pressure to the trachea of a dog through an intratracheal tube (T). An air pump (A) is used as the source of air current. A mercury manometer (B) is placed in the circuit between the ether supply (C) which is an ordinary glass bottle with a wide mouth and a tight fitting rubber cork, and the dog. A safety device (D) is placed between the manometer and the dog. This consists of a graduated glass cylinder containing mercury, with a metal rod, passing through a closely fitting rubber cork and connected to the main air line, leading beneath the surface of mercury to a variable depth on an average between 6-8 cm. depending on the amount of pressure required to blow up the lungs; from our experience a pressure head of about 30 mm. of mercury is required to keep the lungs inflated with the chest laid widely open. Another useful thing we found was to interpose a rubber balloon (E) between the safety valve (D) and the intratracheal tube imi-

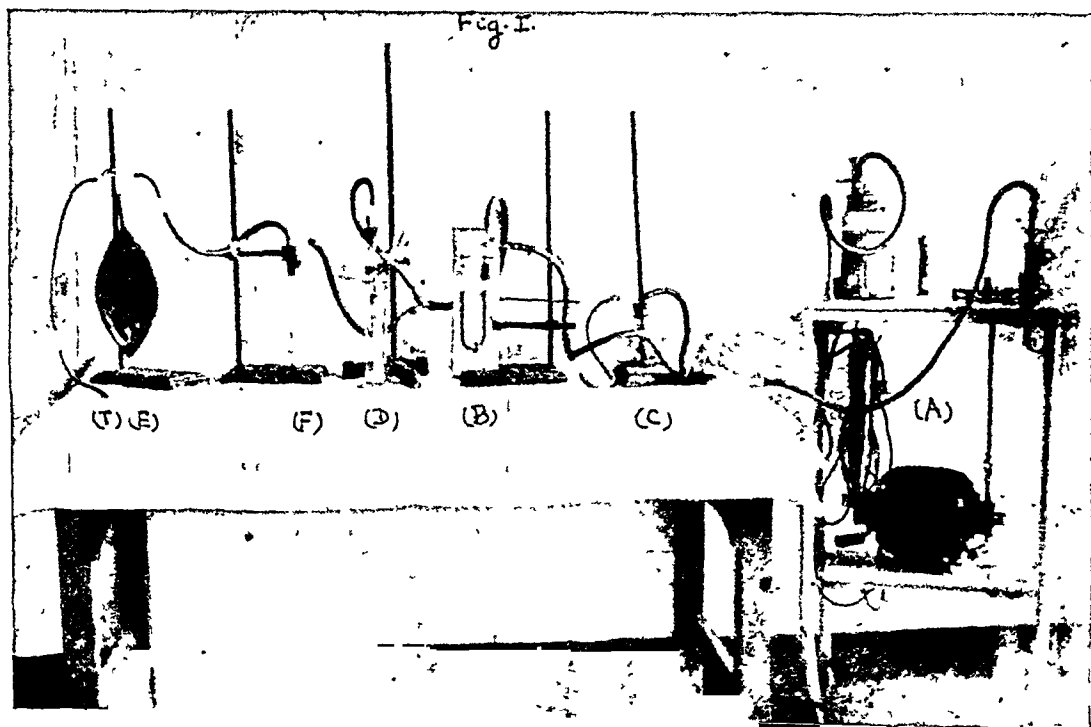


Fig. 1

tating the regular McGills apparatus used in the human being. During intrathoracic operations we could blow up or collapse the lung at will according to the convenience of the operator engaged in Hilar dissection. The system formed a complete closed circuit and we interposed an improvised  $\text{CO}_2$  absorber (F) (a soda lime tower) as well between the safety device D and the dog.

### METHOD

In our research laboratory at Medical College, Lucknow we have been doing lobectomies in dogs with the object of studying the incidence and character of pleural effusion following such an operation. Ordinary stray adult dogs have been used weighing about 6 kgms. A preoperative dose of Morphia gr. 1|4 and atropine gr. 1|150 is given 1/2 hour before the operation. Early on in our experiments we tried to induce the anaesthesia with ether as many of the American authors mention that dogs are prone to develop acute inflammation of the lung with the common chloroform anaesthetic. However at the prevailing temperatures here in Lucknow (90-95°F) we found it impossible to use Ether as a means of induction, using the open method technique which is the only way it can be used with a non-co-operative animal, excluding other basal narcotics which depress the respiratory centre. We therefore used chloroform for induction with a Junkers inhaler and when the animal was sufficiently under a No. 12 rubber catheter was passed through the glottis into the trachea almost to the bifurcation—a distance of 6-8 inches. The throat was packed with a strip of moist gauze. With the intratracheal tube in position the system was a completely closed circuit and now anaesthesia was maintained with an air ether mixture.

The use of the rubber balloon in the circuit is appreciated when the chest is widely opened by a wide intercostal incision and we have found it very useful in inflating or deflating the lung. We used the 6th space in most of our cases for both upper and lower lobe lobectomies. Hilar dissection can be easily and carefully done with the rest of the lung under control which can be expanded and

collapsed as desired. We found that the dorsal position was the most satisfactory one in the dog who has a single pleural cavity and an incomplete mediastinum rather than the lateral position as used in the human being where the two pleural cavities are separated by a comparatively steady mediastinum.

### SUMMARY

A simple apparatus for positive pressure intratracheal anaesthesia in dogs has been described. It is based on the Meltzer-Auer principle and was developed in our surgical research laboratory at Lucknow Medical College. It is simple and inexpensive in both construction and operation. It is less cumbersome than the various differential cabinets available in the market. The absence of post-operative complications with this apparatus seems to indicate that elaborate air filtering and ether warming devices and other automatic equipments are unnecessary. The work on pleural effusions following lobectomies is still in progress and will be reported upon in a later publication.

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# A CASE OF UNUSUAL BLOOD SUPPLY TO THE MAMMARY GLAND\*

By

D. VENKAMMA & Y. APPAJEE

Among the numerous anomalous blood vessels supplying the mammary gland, the following, as far as I have been able to ascertain from the literature available here, has not been recorded. This abnormality was found in a female subject in the course of routine dissection. It was bilateral.

of the forearm. Winding round the lower border of the pectoralis major muscle, the artery lies on the pectoral fascia and enters the outer upper quadrant of the mammary gland on its deep surface. As it courses down through the lateral half of the gland, the artery gives off branches which run trans-

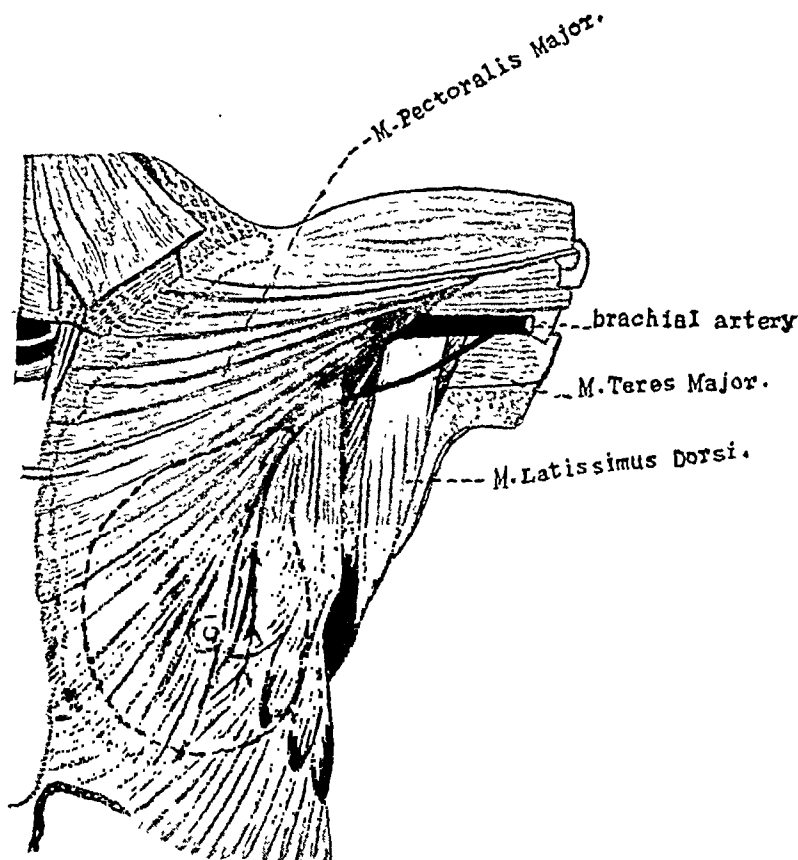


Fig. 1.

Showing the left brachial artery supplying the mammary gland.

On the right side the third part of the axillary artery gives off an additional branch in front of the tendon of the Latissimus dorsi muscle. This last branch is big in size and runs forwards and medially through the floor of the axilla to its anterior wall, crossing the axillary vein and the medial cutaneous nerve

versely and supply it. This artery is therefore a visceral branch from the axillary artery, replacing the external mammary branch of the lateral thoracic artery which, in this case is slender and ends in supplying the serratus anterior muscle.

\*From the Department of Anatomy, Medical College, Mysore.

On the left side, the corresponding anomalous artery arises as the first branch of the brachial artery. It too is considerable in size. It courses forwards and medially through the floor of the axilla, crossing the basilic vein, the medial cutaneous nerve of the forearm and the medial cutaneous nerve of the arm. It reaches the lower border of the pectoralis major muscle and its further course and distribution are the same as of the right artery. (See the figure).

Incidentally other variations are present, which are recorded here.

1. Lateral thoracic artery is very small on both sides and ends purely as a muscular artery to the serratus anterior muscle.

2. The posterior circumflex humeral and the subscapular arteries arise by a common trunk from the third part of the axillary artery on both sides.

3. On the right side the lateral cutaneous branch of T-1 is very prominent and replaces the medial cutaneous nerve of the arm. It receives a small twig of communication from the medial cord of the brachial plexus. So on the right side the medial cord of the brachial plexus gives off only three branches—

- (a) The ulnar nerve,

- (b) The medial head of the median nerve, and

- (c) The medial cutaneous nerve of the forearm.

**DISCUSSION.**—The blood supply to the mammary gland usually comes from two main sources viz.

- (1) The internal mammary artery. Through its perforating branches and the anterior intercostal arteries;

- (2) The axillary artery through the external mammary branch of the lateral thoracic artery.

A combination of two of these usually predominates, the proportion being variable. Anson and his collaborators (1939) deny that the anterior inter-costals ever supply the mammary gland.

In the case under discussion, the lateral thoracic artery is very small and is spent in supplying the muscles. The third part of the axillary artery or the brachial artery supplies the mammary gland. This anomalous origin and superficial course of such arteries across the axilla are the main points of interest. Perhaps one could have felt the pulsations of the artery under the arm pit in the living condition.

Anson and his collaborators describe in their case (above referred to two branches to the mammary gland from the axillary artery viz. (a) a median branch from the lateral thoracic artery—the external mammary branch of the text books, and (b) a larger muscular branch which ran parallel to the axillary artery and gave a lateral mammary branch. The present case is yet another type of variation.

The above authors describe that the main arteries for the mamma form an anastomosis on the superficial surface of the gland from which minute twigs finally penetrate the gland substance and supply it. In the case under discussion, the arteries enter the glands on their deep aspect and run almost vertically downward through the gland tissue necessitating a deep dissection to expose their entire course.

So the statements by Anson and his collaborators that “upon the breast the mammary vessels occupy the most superficial level of the fatty tissue being virtually subcutaneous in position”, and that “from these various mammary rami smaller twigs are given off, at right angles, into the substance of the gland; the more prominent of these are traceable into the mammary tissue to a depth of approximately 2.5 centi meters”, are not tenable.

Surgical aspect of such anomalous arteries is also to be stressed. Because of their superficial course across the axilla the arteries are most easily injured during operations. The presence of such an anomalous artery must be borne in mind by the surgeons while operating on the axilla or the breast. Secondly I agree with Wolfer in the above paper by Anson et al that all the blood vessels for the mamma enter the gland from the upper angles and therefore the best

surgical approach for mastectomy or for exploration will be from the inferior aspect, not only from the cosmetic aspect but because it causes least hæmorrhage.

### SUMMARY

1. A case is recorded in which the terminal part of the right axillary artery and the left brachial artery supply the lateral halves of the mammary glands on either side respectively.

2. Unlike the case described by Anson and his co-workers, the Mammary arteries in the present case do not form a subcutaneous

anastomotic net work before they supply the gland. All the main arteries enter the gland from its deep aspect.

3. Lateral thoracic artery is small and is purely muscular.

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# A CASE OF WHITE ASPHYXIA\*

BY

SUNDARAM PILLAI

Though many cases have been reported, I feel there are some unusual features in the following account which merits publication. It is still no exaggeration to say that many theatres in the country are not equipped for this emergency, and what is more, many are sceptical of the efficacy of cardiac massage. There are various claims for the period of cardiac arrest from which recovery has taken place, but the average time limit is five minutes. The central nervous system can tolerate total arrest for three minutes, and ten seconds, and, even then, there is some permanent alteration in psychic behaviour.

H.S. Male age 68—On December 18th, 1944 underwent a partial cystectomy under light spinal Nupercaine and light general anaesthesia. Just about the time the abdominal wound was being closed the anaesthetist reported the patient had stopped breathing. On examination he was a typical example of white asphyxia. By the time the cardiac massage was started through an upper abdominal incision, it must have been approximately three to four minutes. He was given coramine and artificial respiration was commenced at the same time. The cardiac massage was carried out for about two minutes when the heart started beating again. Some adrenaline was administered into the heart muscle. The patient was returned to the ward and one pint of slow blood drip was given. Intramuscular injection of an extract of supra-renal cortex was also given. Patient was still in deep coma at 9 p.m. Night nurse reported "Patient seems to be semi-conscious but is very dazed." In the morning I visited the ward and to my great surprise he was semi-con-

scious and irrational. He was restless thus for a few days and from the first of January, 1945 his condition started improving. On the third of January he was fully conscious. But on the fourth, he became restless and complained of not being able to pass urine. Two stitches were removed from the supra-public wound and a large blood clot removed. As this did not improve his complaint, he was taken to the theatre on the fifth of January. Under local anaesthesia and intravenous pentothal, the supra-public wound was reopened, all the blood clot removed, the bladder washed out and a supra-public drain put in. His further progress was satisfactory until the twelfth of January, 1945 when the upper abdominal wound burst open with protrusion of omentum. This necessitated his appearance at the theatre again. Under local and regional anaesthesia the abdominal wall was resutured. After this, his convalescence was uneventful and he was discharged fit, passing urine normally per urethra. He was sent to see Dr. F. M. R. Walshe of the National Hospital for Nervous Diseases, and to Dr. Parkinson's Heart Clinic. Both reported that he showed no organic changes as a result of the asphyxia. He was seen periodically and, when last seen, he was fit and active.

In conclusion, the unusual features of this case are that he was able to stand two further surgical manipulations under pentothal and local anaesthesia so soon after his recovery. Though I have seen further examples of cardiac arrest which have not turned out so favourably, I have become a firm believer in this life-saving measure. My own view is that for the measure to be more uniformly successful, one must be optimistic and start the massage as promptly as feasible and in perfect confidence.

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\*From The Royal Hospital, Richmond, Surrey by kind permission of Mr. Harold Dodd.

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### INTERNATIONAL CONFERENCE ON PSYCHO-SURGERY

The first International Conference on Psycho-Surgery is holding a Session in Lisbon, Portugal, on August 5, 6 and 7, 1948. Those interested are requested to communicate with Dr. B. N. Balakrishna Rao, a member of the International Committee, at the following address-for-any-information:—

Dr. B. N. Balakrishna Rao, F.R.C.S., etc.,  
"Manonidhi",  
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\* \* \*

### SUBJECTS FOR DISCUSSION

#### 10th Meeting:

##### 1. Intracranial Tumour.

Opener : Dr. A. V. Baliga, Bombay.

Seconded: Dr. R. N. Cooper, Bombay.

##### 2. Talipes Equinovarus—

Opener: Dr. R. Kalamegam,

Trichinopoly.

Seconded: Dr. M. Bahadur Khan,

Hyderabad.

##### 3. Surgical Complications of Typhoid—

Opener: Dr. V. G. Vaishampayan,

Sholapur.

Seconded: Dr. A. V. Baliga, Bombay.

#### 11th Meeting:

##### 1. Treatment of Elephantiasis and Lymph Oedema—

Opener: V. P. Mehta, Bombay.

Seconded: T. Kanakaraju,

Ramachandrapuram.

##### 2. Treatment of Hernia with Fascial Grafts and Silk Sutures—

Opener: P. Chatterjee, Calcutta.

Seconded: S. K. Datta, Calcutta.

##### 3. Treatment of the Bone Cavities in Chronic Osteomyelitis—

Opener: D. K. Sabhesan, Vizagapatam.

Seconded: B. N. Sinha, Lucknow.

